ELREHA

Technical Manual
Cold Storage Controllers
TKP / TKC x130
TKP / TKC x140

No. 5310902-11/10 E
from Software Vers. 2.30 resp. 4.xx

Characteristics briefly

The TKP / TKC Controller series includes all necessary functions used in refrigeration and freezing applications:

- refrigeration controller for all applications of cold stores, freezers, shelfs, chest freezers...
- for use as single controller or in a network
- 6 inputs for temperature sensors
- 6 relay outputs
- 4 digital inputs (mains voltage)
- 1 analog output
- each input and output can be assigned to a certain function.
- available in three different housings

Some Standard Functions

- **LC-Display**, dot-matrix, plain text
- **Operation by 4 keys on the front**
- **Temperature control for up to 4 circuits**
- **2nd setpoint** (day / night shift)
- **Alarm thermostat** with monitoring of each evaporator
- **Compressor Idle-Time**
- **Fan control** with delay times for start and stop
- **Runtime monitoring** of refrigeration
- **Roller blind control**
- **Frame heater control**, pulsed, different for day and night
- **Analog output** usable for actual value image or for **P, PI, PID-T1**-control with service functions
- Adjustable **Emergency Mode**
- **Door contact input**

Please note Safety Informations !

Intelligent defrost control, able to learn (x140 only)

- Works with the 2 standard temperature sensors only: **Room sensor, evaporator sensor**
- **Autoadaptive Defrost Demand Recognition, suitable both for single compressor applications and for compound systems.**
- **Defrost Start**: fully automatic, 6 release times or manually
- **Defrost cycle is pulsed**, controlled by evap sensor (variable intervals)
- **Automatic recognition of the leading evaporator** at cold storages with several evaporators
- **Emergency Mode** if sensor or defrost recognition fails. Autoreset if malfunction is repaired.

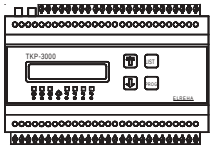
Use of Latency Heat

- **Fan following** (less compressor starts)
- **Intelligent fan control** before defrost
- **Special mode if room temperature is above 2,5°C** The evaporator will be defrosted by airflow during the refrigeration periods (less defrosts necessary).

Contents

Available Types

- **TKP 3130** 230V, for DIN-rail
- **TKP 3130/1** without display and keys, TF 501 (Pt1000) sensors only
- **TKP 3140** like 3130 but with intelligent defrost

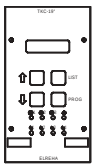


- **TKP 23130** 110V, for DIN-rail
- **TKP 23140** like 23130 but with intelligent defrost

- **TKC 5130** 230V, panel mounting (96x96mm)
- **TKC 5140** like 5130 but with intelligent defrost

- **TKC 25130** 110V, panel mounting (96x96mm)
- **TKC 25140** like 25130 but with intelligent defrost

- **TKC 19130** 230V, 19"-Al-cassette, 14 TE
- **TKC 19140** like 19130 but with intelligent defrost



- **TKC 29130** 110V, 19"-Al-cassette, 14 TE
- **TKC 29140** like 29130 but with intelligent defrost

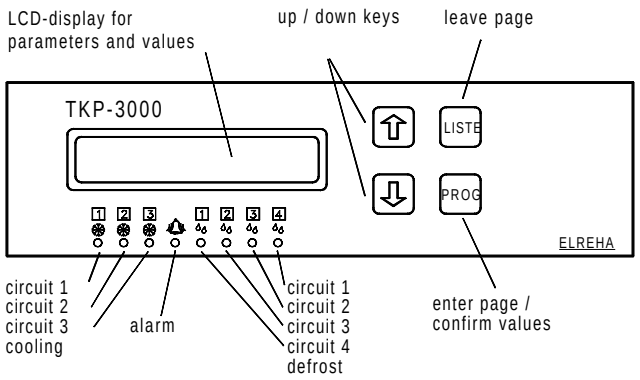
Operating / Operating Elements

The operating elements of all TKP/TKC-types are identical, independent from their housing.

The units can be operated by 4 keys, all parameters will be displayed in plain text on the backlighted LC-display.

The TKP 3130/1 will be operated from keypad and display of the VPR Compound Control System.

Operating Elements



Programming

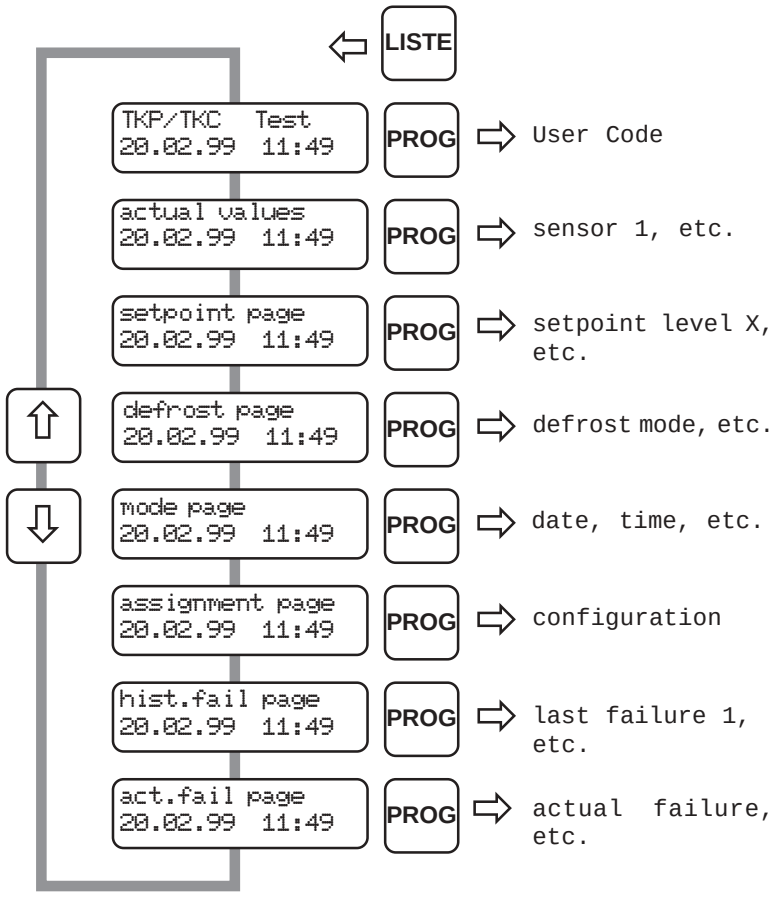
All readable and adjustable values (parameters) of the **TKx** units are listed on several pages. While normal operation or if no key is pressed for about 3 minutes, the display shows the following informations:

1. priority: current failure (only if there is a failure at the moment)
2. priority: controller states (e.g. if it is turned OFF by a digital input)
3. priority: the selected 'Basic Display'

Call up and changing of parameters:

Key	Action
LISTE (= ESC),	If no pagename is displayed
⇧ ⇩	Select desired page
PROG	Enter this page
⇧ ⇩	Select parameter
PROG	Start programming, parameter name flashes. Eventually, the unit asks here for an access code ('Identification', see next page)
⇧ ⇩	Adjust desired value. Pressing and holding a key effects that the value will be incremented or decremented automatically faster and faster.
PROG	Leave programming mode, confirm new value
Liste (= ESC)	Back to page overview.

Parameter Pages



Access Protection / Unauthorized changing of parameters

User levels

To avoid that unauthorized persons change parameters, the parameters are access protected until a correct code is entered.
3 different user levels exist:

1. **Customer Level**
   In this level only setpoints can be changed or defrost can be started manually, but it is impossible to change the configuration of the unit.

2. **Service Level** (call-up with code 2)
   Here the service contractor finds parameters and information for start-up and service.

3. **Configuration Level** (call-up with code 3)
   Here you can change all parameters, even the fundamental functions to assign inputs and outputs.

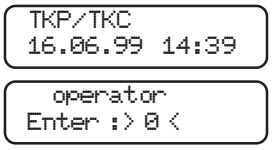
In the single levels only the accessable parameters will be displayed (marked by 'Level 1,2,3' on the parameter pages).

Using the Access Protection

The parameter „*operator layer*“ on Mode Page is factory set to „no“. Thus you will see all parameters, the same as if the 'Configuration-Level' would be active.
After start-up, you protect the controller unit effectively by changing parameter „*operator layer*“ (mode page) to „yes“. If you don't touch any key for at least 3 minutes or if you switch off power for a moment, protection will be activated. Thus only the parameters of the **Customer Level** can be displayed.
All other parameters are hidden now and can be accessed only by knowing the code.

To change from Customer Level to Service- or Configuration Level do as follows:

- Select 'basic Display',
- Press key "Prog",
- Enter code for desired level.



Change parameters

To change a parameter in the single user levels, the unit frequently expects an additional 'Identification Code'. (see right column).
As long as parameter "*operator layer*" is not set to "no", the unit changes to the **Customer Level** if no key is pressed for about 3 minutes.

Codes

Code 2: ..... Fixed Code: - **88** - (calls up Service Level)

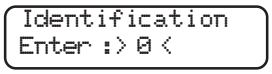
Code 3: ..... **Month + Hour + 20** (calls up Configuration Level)

Example:
(Note: Real-time clock must be set to the right time and date before.)
You want to change a parameter at a day in june at 9:35 in the morning. Identification Code = 6 + 9 +20 = **35**.

Identification

Almost all parameters, except the temperature setpoints, are protected by a simple password.

If you have to change a parameter and you have pressed the "PROG"-key, this display appears:



The controller expects now the input of a code-no.

This code-no. (Code 1) is related from the actual time of the day as the sum of the

hour (0 to 23) plus 10

Example:
At 9:35 a.m. the code is 9 + 10 = 19.
At 21:35 (9:35 p.m.) the code would be 21 + 10 = 31.

If you have pressed no key for about 3 minutes, the parameters are locked again automatically.

Parameter pages

Actual Values	Disp only	Level	Range	Default val.	Your value
sensor 1 xxxxxx[x]		1	Display of the temperature of this sensor range -100/+100°C, calibration range here is +/- 10K [x] indicates the function assigned to this sensor: **Rx** = control sensor x, **Wx** = alarm sensor x **DO** = display only sensor, **w1** = defrost demand sensor warm x **c1** = defrost demand sensor cold x **Dxy** = evap sensor, circuit x / no.y	calibr. = 0	
sensor 2		1	dto.	calibr. = 0	
sensor 3		1	dto.	calibr. = 0	
sensor 4		1	dto.	calibr. = 0	
sensor 5		1	dto.	calibr. = 0	
sensor 6		1	dto.	calibr. = 0	
run time refr. 1	X	1	refrigeration runtime today	00:00	
thru					
run time refr. 4	X	1		00:00	
door open 1	X	1	total door open time today	00:00	
thru					
door open 4	X	1		00:00	
rem. door open 1	X	2	remaining time before alarm		
thru			"door open" ("---" = door closed)		
rem. door open 4	X	2	h:min:sec		
remain alm delay	X	2	remaining time before temperature alarm		
remain defr time	X	2	remaining defrost time in mm:ss		
rem. defr pause 1	X	2	h:min:sec		
thru					
rem. defr pause 4	X	2			
remain fandelay 1	X	2	h:min:sec		
thru					
remain fandelay 4	X	2			
rem compr pause1	X	2	h:min:sec		
thru					
rem compr pause4	X	2			
rem strt sec ch(ain)	X	2	h:min:sec		
rem chck defrdem	X	2	min:sec	00:00:00	
dem defr stored	X	2	yes, no	no	
solenoid valve	X	2	enabled, off		
status	X	1	off circuit X		
night settings	X	1	day, night		
runtime relay 1		2	h:m:s (resettable only)	00:00:00	
thru					
runtime relay 6		2		00:00:00	
analog value	X	1	output is X% of the selected range		
OC1 OC2 OC3 OC4	X	1	voltage at this digital inputs		
relay status	X	1	state of relays 1-6, 1=ON, 0=OFF		

Parameters marked with "**Disp. only**" are for Information only and cannot be adjusted.

The numbers in column "**Level**" show the user level, where this parameters are displayed.

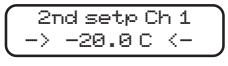
Setpoint page	Level	Range	Default-value	*Examples* walk-in fr.	chest fr.	walk-in (+4°)	refrig. shelf	Your Value
setpoint layer	1	1, 2	1	1	1	1	1	
setpoint Ch 1	1	-50/+50°C	-20°C	-20°C	-26°C	+4°C	+1°C	
setpoint Ch 2	1	-50/+50°C	-20°C	---	---	---	+3°C	
setpoint Ch 3	1	-50/+50°C	-20°C	---	---	---	---	
setpoint Ch 4	1	-50/+50°C	-20°C	---	---	---	---	
2nd setp Ch 1	1	-50/+50°C	-20°C	---	- 24°C	---	+3°C	
2nd setp Ch 2	1	-50/+50°C	-20°C	---	---	---	+5°C	
2nd setp Ch 3	1	-50/+50°C	-20°C	---	---	---	---	
2nd setp Ch 4	1	-50/+50°C	-20°C	---	---	---	---	
alt setp Ch 1	1	-50/+50°C	-20°C	---	---	---	---	
alt setp Ch 2	1	-50/+50°C	-20°C	---	---	---	---	
alt setp Ch 3	1	-50/+50°C	-20°C	---	---	---	---	
alt setp Ch 4	1	-50/+50°C	-20°C	---	---	---	---	
alt 2nd setp Ch 1	1	-50/+50°C	-20°C	---	---	---	---	
alt 2nd setp Ch 2	1	-50/+50°C	-20°C	---	---	---	---	
alt 2nd setp Ch 3	1	-50/+50°C	-20°C	---	---	---	---	
alt 2nd setp Ch 4	1	-50/+50°C	-20°C	---	---	---	---	
warning offset	2	0...50K (relative to the active setpoint)	7 K	---	15K	5K	50K	
alt warn offset	2	0...50K (relative to the active setpoint)	7 K	---	---	---	---	
warn low limit	2	-50/+50°C (absolute value)	- 22°C	off	off	2°C	-35°C	
alt warn low lim	2	-50/+50°C (Absolutwert) (absolute value)	- 22°C	off	off	2°C	-35°C	
hysteresis	2	0,1...20K	2 K	2K	4K	2 K	2 K	
PID propor band	2	0,1...30K	4 K	---	---	---	---	
PID integr time	2	off, 00:00 thru 10:00 min:sec	10 sec.	---	---	---	---	
PID attack time	2	off, 00:00 thru 00:10 min:sec	off	---	---	---	---	
PID delay	2	off, 0,1 thru 10 sec.	off	---	---	---	---	
opto->analog val.	2	0,0...100,0 %, voltage / current from analog output with activated digital (OC-) input	0%	---	---	---	---	
fan start delay	2	0:00:00 thru 0:30:00 (h:min:sec), freeze-on time	0:05:00	0:03:00	---	0:03:00	---	
fan off delay	2	00:00 thru 30:00 min:sec	00:00	0:02:00	---	0:02:00	---	
warning delay	2	0:00:00 thru 2:00:00 (h:min:sec)	0:45:00	1:00:00	1:00:00	1:00:00	1:00:00	
cooling limit	2	0:00 thru 23:59 (h:min), off	off	---	---	---	---	
door time limit	2	0:00 thru 23:59 (h:min), off	off	---	---	---	---	
refrDlyAftMnsOff	2	0...30 min	0 min					
compr. pause	2	00:00 thru 30:00 hh:mm	00:00	---	---	---	---	
OC inp alm delay	2	00:00 thru 02:00 hh:mm	00:05	---	---	---	---	
door alm delay	2	00:01 thru 04:00 hh:mm	00:05	---	---	---	---	
sec chain delay	2	00:00 thru 01:00 min:sec	01:00	---	---	---	---	

- Parameters marked with "**Disp. only**" are for Information only and cannot be adjusted.

- The numbers in column "**Level**" show the user level, where this parameters are displayed.

- The current active setpoints / alarm offsets / alarm limits are marked by additional arrows in the display.

Example:



Defrost page	Disp only	Le-vel	Range	Dim.	Default-value	*Examples* walk-in fr.	chest fr.	walk-in (+4°)	refrig. shelf	Your value
defrost type (fan dur.defr.)		2	on, off		off	off	- - -	on	- - -	
defrost mode		2	extern(al only), extern+intern difference meth., dem def by opti, adaptive *		extern +intern	ext/int	ext/int	ext/int	ext/int	
defrost time 1		1	00:00 - 23:59, off	hh:min	5:00	6:00	5:00	5:00	5:00	
defrost time 2		1	00:00 - 23:59, off	hh:min	off	21:00	20:00	11:00	13:00	
defrost time 3		1	00:00 - 23:59, off	hh:min	off	off	off	17:00	21:00	
defrost time 4		1	00:00 - 23:59, off	hh:min	off	off	off	23:00	- - -	
defrost time 5		1	00:00 - 23:59, off	hh:min	off	off	off	- - -	- - -	
defrost time 6		1	00:00 - 23:59, off	hh:min	off	off	off	- - -	- - -	
defr temp limit 1		2	(control circuit 1) 0,0°C....50,0°C	°C	14°C	8°C	8°C	8°C	8°C	
defr temp limit 2		2	(control circuit 2) 0,0°C....50,0°C	°C	14°C	- - -	- - -	- - -	8°C	
defr temp limit 3		2	(control circuit 3) 0,0°C....50,0°C	°C	14°C	- - -	- - -	- - -	8°C	
defr temp limit 4		2	(control circuit 4) 0,0°C....50,0°C	°C	14°C	- - -	- - -	- - -	- - -	
last defr cycle 1	**X**	2	(circuit 1) min:sec	mm:ss	00:00	- - -	- - -	- - -	- - -	
last defr cycle 2	**X**	2	(circuit 2) min:sec	mm:ss	00:00	- - -	- - -	- - -	- - -	
last defr cycle 3	**X**	2	(circuit 3) min:sec	mm:ss	00:00	- - -	- - -	- - -	- - -	
last defr cycle 4	**X**	2	(circuit 4) min:sec	mm:ss	00:00	- - -	- - -	- - -	- - -	
n/o defr ignored	**X**	2	0, 1, 2, 3, 4, 5, 6		0	- - -	- - -	- - -	- - -	
demand defr diff		2	0,0...20,0K	K	5K	- - -	- - -	- - -	- - -	
dem defr period		2	00:00...10:00 mm:ss	mm:ss	02:00	- - -	- - -	- - -	- - -	
pulsedef. limit		2	-5,0...+50,0°C	°C	50,0°C	+3°C	50°C	+3°C	50°C	
defr alarm delay		2	00:00 thru 60:00	mm:ss	30:00	30:00	30:00	30:00	30:00	
pause ahead defr		2	0...15 min	min	0					
pause aft. defr		2	00:00 thru 30:00	mm:ss	00:00	1:00	00:00	00:00	00:00	
n/o.def.evnt > alm		2	Number of defrost cycles without alarm, off, 1-15	3		off	off	off	off	
max defrost time		2	00:00 thru 4:00:00	mm:ss	45:00	45:00	45:00	30:00	45:00	
manual defrost		1	start, finish			- - -	- - -	- - -	- - -	
* defrost forerun		2	00:00 thru 00:15	hh:mm	00:03					
* time (up) to defr	X	2	hh:min:sec							
* max time to defr		2	02:00 thru 48:00	hh:mm	24:00					

***** in TKP/TKC x140 only.
- Parameters marked with "**Disp. only**" are for Information only and cannot be adjusted.
- The numbers in column "**Level**" show the user level, where this parameters are displayed.

Mode page	Disp only	Level	Range	Dim.	Default-value	*Examples* walk-in fr.	chest fr.	walk-in (+4°)	refrig.shelf	Your value
compound		2	1, 2, none		1	2 (TK)	2 (TK)	- - -	- - -	
fan operation		2	interval, permanent		interval	interval	- - -	interval	- - -	
cooling mode		2	refrigeration, freezing		refrigeration	freezing	freezing	refrigeration	refrigeration	
emergency operat.		2	0...100%		0%	60%	80%	50%	50%	
frame period		2	10:00...60:00 mm:ss		15:00 mm:ss	- - -	30:00	- - -	- - -	
frame pulse day		2	0...100%		100%	- - -	80%	- - -	- - -	
frame pulse nigt		2	0...100%		100%	- - -	40%	- - -	- - -	
alm temp. low		2	yes, no		yes	no	no	yes	yes	
night setp ON		2	0:00 thru 23:59, off		off	- - -	- - -	- - -	20:00	
night setp OFF		2	0:00 thru 23:59, off		off	- - -	- - -	- - -	6:00	
runtime mess at		2	0...23 h		6 h	- - -	- - -	- - -	- - -	
corr sensor 1		2	calibration offset, adjustable +/-10 (actual value also adjustable)	K		- - -	- - -	- - -	- - -	
corr sensor 2		2	calibration offset, adjustable +/-10 (actual value also adjustable)	K		- - -	- - -	- - -	- - -	
corr sensor 3		2	calibration offset, adjustable +/-10 (actual value also adjustable)	K		- - -	- - -	- - -	- - -	
corr sensor 4		2	calibration offset, adjustable +/-10 (actual value also adjustable)	K		- - -	- - -	- - -	- - -	
corr sensor 5		2	calibration offset, adjustable +/-10 (Istwert dto. einstellbar)	K		- - -	- - -	- - -	- - -	
corr sensor 6		2	calibration offset, adjustable +/-10 (actual value also adjustable)	K		- - -	- - -	- - -	- - -	
sensor (type) !! 3130/1=Pt1000 only		3	TF 201 (PTC), TF 501 (Pt 1000)		Pt1000	!	!	!	!	
unit text		3	unit name as desired		TKP	- - -	- - -	- - -	- - -	
operator layer		3	yes, no		no	- - -	- - -	- - -	- - -	
program version	**X**	1	version no. of this program			- - -	- - -	- - -	- - -	
summer / winter		3	no, EU up to 1995, EU from 1996		EU from 1996	EU from '96	EU ab '96	EU from '96	EU from '96	
actual time		2	h:min:sec			- - -	- - -	- - -	- - -	
actual date		2	day:month:year			- - -	- - -	- - -	- - -	
Sprache / language		2	deutsch, english, francais, Nederlands			- - -	- - -	- - -	- - -	
baudrate		3	1200, 2400, 4800, 9600		9600	9600	9600	9600	9600	
adress in netwk		3	0 - 78			- - -	- - -	- - -	- - -	

- Parameters marked with "**Disp. only**" are for Information only and cannot be adjusted.
- The numbers in column "**Level**" show the user level, where this parameters are displayed.

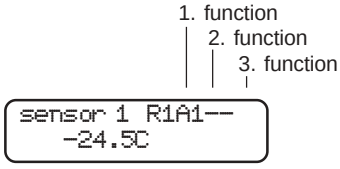
Assignment page	Level	Range	Default value	*Examples*			
				walk-in fr.	**chest fr.**	**walk-in (+4°)**	**refrig. shelf**
function relay 1 defr. 11 thru 44 means: defrost yz y=circuit, z=evaporator *Example:* defr.11 = defrost relay control circuit 1, evaporator 1	3	--, on, refrig. 1, refrig.2, refrig.3, refrig.4 defrost11, defrost12, defrost13, defrost14, defrost21, defrost22, defrost23, defrost24, defrost31, defrost32, defrost33, defrost34, defrost41, defrost42, defrost43, defrost44, fan 1, fan 2, fan 3, fan 4, unit on alarm, frame heater, roller blind, light, heater 1	alarm	alarm	alarm	alarm	alarm
function relay 2	3	dto.	refrigeration 1	refrig. 1	refrig. 1	refrig. 1	refrig. 1
function relay 3	3	dto.	refrigeration 2	fan 1	frame heater	fan 1	refrig. 2
function relay 4	3	dto.	frame heater	defr. 1/3	defr. 1/3	defr. 1/3	roller blind
function relay 5	3	dto.	defrost 21	defr. 1/2	defr. 1/2	defr. 1/2	off
function relay 6	3	dto.	defrost 11	defr. 1/1	defr. 1/1	defr. 1/1	refrig. 3
function Opto. 1 (digital input OC 1)	3	---, manual defrost, night settings, unit OFF actHigh, security chain, setpoint layer, door contact 1...4 alarm input 1,alarm input 2 alarm input 3, alarm input 4, circuit OFF 1 - - - thru circuit OFF 1 2 3 4, analog value, refLock actLow, refLock actHigh, refForce actLow, refForce actHigh, unit OFF actLow, circ.OFF.low 1 - - - thru circ.OFF.low 1 2 3 4	man. defrost	m. defrost	m. defrost	m. defrost	m. defrost
function Opto. 2	3	dto.	night settings	night sett.	night sett.	night sett.	night sett.
function Opto. 3	3	dto.	controller OFF	contr. OFF	contr. OFF	contr. OFF	contr. OFF
function Opto. 4	3	dto.	- - -	setp. layer	setp. layer	setp. layer	setp. layer
funct. sensor 1a	3	- - - (sensor is switched OFF), control sensor 1 ... control sensor 4, defr sensor **x/x** = defrost sensor **circuit x** / **no. x,** demdefr sens co1, demdefr sens wa1, alarm sensor 1 thru alarm sensor 4, disp only sens	control sens. 1	contr.sens1	alm sens 1	contr.sens.1	contr.sens. 1

Assignment page	Level	Range	Default value	*Examples*			
				walk-in fr.	chest fr.	walk-in (+4°)	refrig. shelf
funct. sensor 1b	3	dto.	alarm sensor 1	alm sens 1	- - -	alm sens 1	alm sens 1
funct. sensor 1c	3	dto.	- - -	- - -	- - -	- - -	- - -
funct. sensor 2a	3	dto.	defr. sens. 1/1	defr.s 1/1	defr.s 1/1	defr.s 1/1	defr.sens1/1
funct. sensor 2b	3	dto.	- - -	- - -	contr.sens 1	- - -	alm sens. 1
funct. sensor 2c	3	dto.	- - -	- - -	- - -	- - -	- - -
funct. sensor 3a	3	dto.	control sens. 2	alm sens. 1	alm sens. 1	alm sens. 1	defr.sens1/2
funct. sensor 3b	3	dto.	alarm sensor 2	- - -	- - -	- - -	alm sens. 2
funct. sensor 3c	3	dto.	- - -	- - -	- - -	- - -	- - -
funct. sensor 4a	3	dto.	defr. sens. 2/1	defr.s 1/2	defr.sens 1/2	defr.sens 1/2	contr. sens 2
funct. sensor 4b	3	dto.	- - -	- - -	contr. sens 1	- - -	alm sens. 2
funct. sensor 4c	3	dto.	- - -	- - -	- - -	- - -	- - -
funct. sensor 5a	3	dto.	disp only sens	alm sens. 1	alm sens. 1	alm sens. 1	defr.sens1/3
funct. sensor 5b	3	dto.	- - -	- - -	- - -	- - -	alm sens. 3
funct. sensor 5c	3	dto.	- - -	- - -	- - -	- - -	- - -
funct. sensor 6a	3	dto.	disp only sens	defr.s 1/3	defr.sens 1/3	defr.sens 1/3	contr. sens 3
funct. sensor 6b	3	dto.	- - -	- - -	- - -	- - -	alm sens. 3
funct. sensor 6c	3	dto.	- - -	- - -	- - -	- - -	- - -
analog function	3	0V, 4mA, 10V / 20 mA act.img 0-10V, act.img 4-20mA, PID-T1 0-10V, PID-T1 4-20mA PID-T1 10-0V, PID-T1 20-4mA	act.img 0-10V	- - -	- - -	- - -	- - -
O 1/2 - O 3/4	2	state of the digital (OC)-inputs 1-4		display only			
R 1/3 - R4/6	2	state of the relays 1-6		display only			

Display of actual values and states

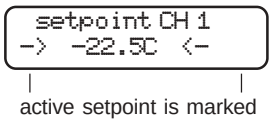
All actual values are shown on the '*actual values*' page.

Display of the temperatures
'*sensor1*' to '*sensor 6*' display their actual value in the range of -50 ... +100°C. On the same time, the display shows the functions which are assigned to the sensor.



Sensor corrections can be made by editing each individual sensor reading. The resulting correction factors are listed on the mode page (*corr sensor 1-6*).

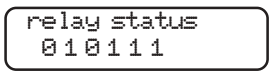
Setpoints:
The active day or night set-points are indicated on the display by „->“ and „<-“.



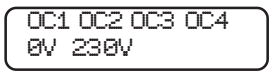
Information about delay times
On the actual values page you will find all remaining delay times, so it is easy to verify the points in time when specific functions must start.

Status Displays

Relay 1.....Relay 6



Optocoupler 1.....Optocoupler 4



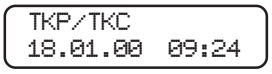
Temperature Sensors

There are two types of temperature sensors which can be used:
- **TF 201**, PTC sensor (2000 ohms@25°C), !! not 3130/1 !!
- **TF 501**, PT1000 sensor (1000 ohms@0°C)

The type must be preset by '*sensor*' (mode page).

'Permanent Parameter' - Function (Basic Display)

After switching on the controller, the display will indicate the 'permanent parameter' after some seconds (or in case of a failure it will display the actual failure):



This will also be showed if you have selected some parameters and you don't touch a button for more than 3 minutes.

If you think that it is suggestive to show any sensor value as permanent parameter, do the following:

Change permanent parameter

- Select parameter you want to have as 'permanent parameter'
- Press ⇧ and ⇩ simultaneaously.
  The display becomes dark for a moment, after that the selected parameter will be shown as basic display.

Failure Messages / Failure Memory / Failure Codes

All failures will be memorized with date and time of their appearance. To display this messages, 2 pages exist:

Actual failures page

This page contains all current failures in a short form. To make more than one current failure visible, use the 'up/down'-keys. If a sensor is short or broken, this message also appear on the actual value display.

Historic failures

On this page you will always find the last **15** failures memorized with date and time of their appearance.

Failure Codes	
----	no failure
Init	first initialisation of the controller or data lost
Hard	hardware failure
MOFF	mains supply cut off
MON	mains supply switched on
SiCh	security chain open
SBr X	sensor X broken
SSH X	sensor X short
If a sensor is short or broken, a time delay of 5 seconds takes effect before an alarm will be activated.	
HT X	one of the alarm sensors of circuit X high temperature
LT X	one of the alarm sensors of circuit X low temperature
MRC X	cooling of circuit X has exceeded maximum runtime. This message is only active up to '*runtime mess at*' (mode page).
OPC X	alarm on digital (OC) input X, assigned as alarm input
DOR X	door contact of circuit X open too long. This message is only active up to '*runtime mess at*' (mode page).
DEF X	number of defrost cycles without termination by temperature exceeded in circuit X, maybe too many ice or heater malfunction.
ASSI	error on assignment page, e.g. function programmed too often
COon	controller unit switched ON by interface or by digital input
COof	controller unit switched OFF by interface or by digital input
OFF X	circuit X switched off by interface or by digital input

Configuration Concept

As a refrigeration contractor or a planning engineer you often have the problem to get the right cold storage controller that fits perfectly to your application. By using the TKP3130 this problem is no longer the issue, since this controller is designed to be universal. Its **'free configurable**' concept enables you to use it for almost all refrigeration applications.
The 'free configurable' concept means that all controller inputs and outputs (*6 relays, 6 sensors, 4 digital (OC)-inputs, 1 analog output*) can be configured to work with any integrated control functions or control circuits.

Sensors
Each sensor can fulfill each function, even up to 3 functions at the same time (function sensor X a, function sensor X b, function sensor X c, X = sensor no.).
e.g. cold store: function sensor 1 is:
1a: control sensor and
1b: alarm sensor
or refrigerated shelf: function sensor 1 is:
1a: control sensor,
1b: defrost sensor and
1c: alarm sensor.

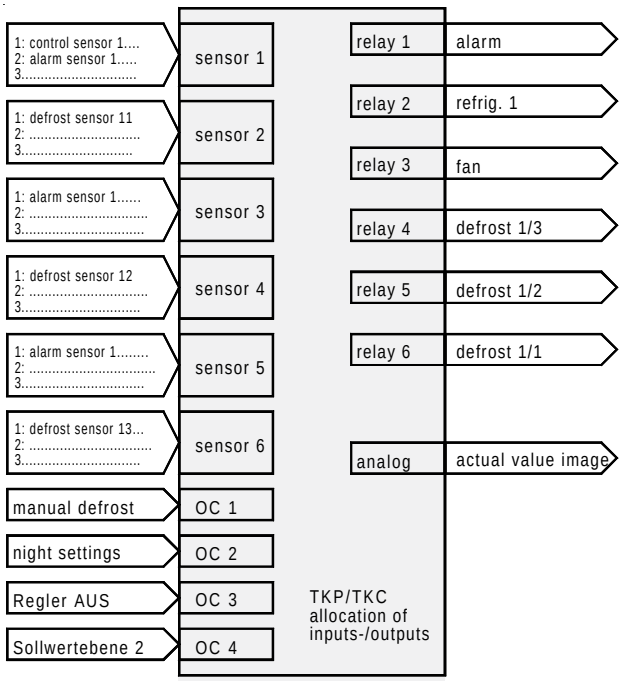
Digital Inputs (OptoCoupler Inputs)
Each digital input can be assigned to one of the possible functions.

Relay Outputs
Each relay can be used to control one of the possible functions. The same function can even be allocated to multiple relays.

Parameters
Parameters of functions which are not assigned will not appear in the parameter pages to improve survey.

Assignment
The function of each input and output can be preset on the 'assignment page'. The assignment can be done by the keys or via interface.

Example of a configuration for a freezer with 3 evaporators:



Configuration of the controller

Hereby we use the example from above: freezer with 3 evaporators

action	key	display	remarks
select assignment page	"⇧⇩"	assignment page 05.06.01 14:10	
enter assignment page	"**PROG**"	function relay 1 ---	
select desired output	"**PROG**"	identification Enter :> 0 <	at the beginning of programming only, or after no key is pressed for about 3 minutes
enter code depending on time	"⇧⇩"		
confirm	"**PROG**"	function relay 1 ---	flashing
select function for this output	"⇧⇩"	function relay 1 alarm	flashing
confirm	"**PROG**"	function relay 1 alarm	flashing stops, relay already working
select new input/output	"⇩"	function relay 2 ---	
prepare for programming	"**PROG**"	function relay 2 ---	flashing
select function for this output	"⇧⇩"	function relay 2 refrig. 1	flashing
confirm	"**PROG**"	function relay 2 refrig. 1	flashing stops, relay already working
select new input/output	"⇩"	function relay 3 ---	
prepare for programming	"**PROG**"	function relay 3 ---	flashing
select function for this output	"⇧⇩"	function relay 3 fan 1	flashing
confirm	"**PROG**"	function relay 3 fan 1	flashing stops, relay already working

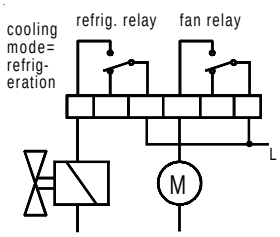
Repeat this steps until all inputs and outputs are assigned to the desired functions.

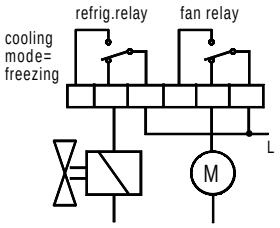
Cooling

Control circuits
This controller is able to control up to 4 independent cooling circuits, each with an own setpoint.

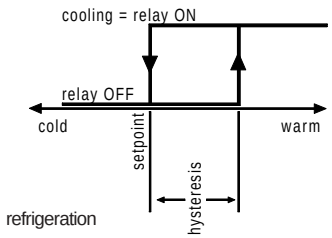
Temperature sensors
Two control sensors can be assigned to each circuit. If *one of them* gets warmer than setpoint plus hysteresis then cooling starts. Cooling doesn't stop *until both* have achieved the setpoint.

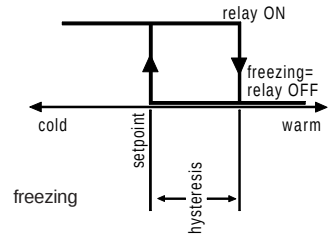
Cooling
Cooling is controlled by switching the output relay. In case of power loss or controller defects the contacts must switch in a position which is safe for the application. For this reason we are using the N/O-contact for refrigeration applications (fail-safe: open contacts). For freezing applications we use the N/C-contacts (fail-safe: closed contacts).





This can be set by parameter *"cooling mode"* (mode page). The point of cut-off is always the valid setpoint.
The selection of this parameter also affects to the switching characteristic of the fan relay.





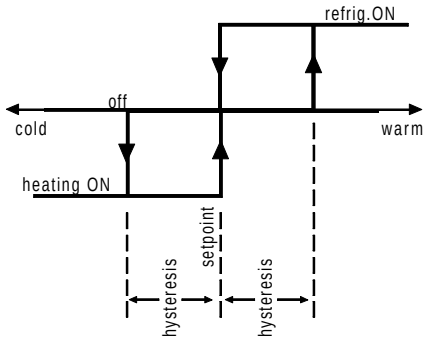
The refrigeration relay can be disabled via interface (see chapter "networking via E-Link").

Refrigeration delay after power up
The start of refrigeration after power-up resp. mains loss can be delayed by parameter "*refrDlyAftMnsOff*" (Setpoint Page). In plants with many cold storages this function prevents that after power-up all solenoid valves open at the same time, even though not enough machine power is present yet.

Heating function

For one relay it is possible to assign the function of heating circuit 1.
The setpoint is the cut-off of heating and cooling at the same time.

The cut-in will be:
- for cooling at setpoint + hysteresis and
- for heating at setpoint - hysteresis.



Runtime Monitoring

The controller monitors the total running hours per day of the cooling outputs. This values are displayed under parameters „*run time refr. x*" for each circuit. One day counts from the time of the parameter „*runtime mess at*" (mode page) until the same time of the next day.

Example:
"*runtime mess at*" set to 11:00.
Monitoring time range is from 11:00 o'clock day 1up to 10:59 o'clock day 2.

A parameter „*cooling limit*" can be set to a reasonable value (hours per day) which, when exceeded on three days in a sequence, will cause an alarm at the hour programmed by „*runtime mess at*". Then the alarm relay will be de-activated and the alarm LED goes on.

This alarm will be cancelled automatically 1 hour later.

Operation with a single compressor

If a single compressor is controlled by a refrigeration relay, it is suggestive to have an idle time to prevent the machine from damages caused by short cycle operation. The compressor can restart only after the timer "*compr. pause*" (setpoint page) is run down. The remaining time up to the compressors restart can be read at "*rem.compr pause X*" (actual page).

Second setpoint (night operation)

For each of the 4 circuits a second setpoint is available (*2nd setp Ch X*). This can be used for night operation or other energy savings. The toggling between these setpoints can be made by the internal clock or by digital input. The setpoint which is in use at the moment is marked by two arrows like: „—> -20,0°C <—". In the actual values page you see also if day or night setpoint is in use.

Internal toggling
The parameters „*night setpt ON*" (mode page) and „*night setpt OFF*" determine the period when the 2nd setpoint will be active. If the function 'night settings' is assigned to one of the digital inputs, it must be connected to mains phase. If the internal timer is not used, set '*night setp. ON*' and *'night setp. OFF*' times to „OFF".

External toggling
If the 'night settings' input is open, the 2nd setpoint is activated all time and the internal timer is disabled. With this digital input to mains phase, the normal (1st) setpoint is activated and the internal timer is enabled.

Second Set of Setpoints

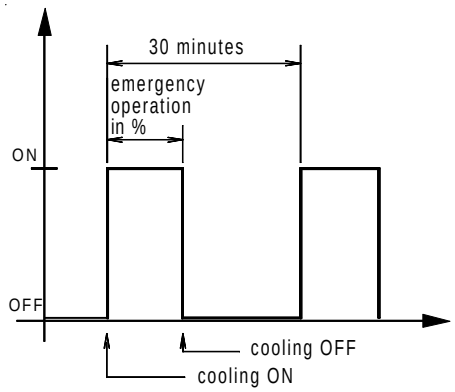
The controller offers two sets (layers) of setpoints, where the first layer of setpoint is used during normal operation and the alternative layer of setpoints with other temperatures is used e.g. for other products which will be stored only sometimes. For each layer there are parameters for the setpoints, the night setpoints, warning offsets and low temperature warning. The names of the second set parameters begin with '*alt*....'.

Toggling between the setpoint layers

1. internal: with parameter „*setpoint layer*"
2. external: assign function „setpoint layer" to a digital input. If connected to mains phase, the 2nd layer is in use.

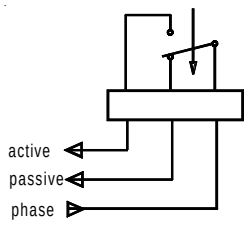
Emergency Operation of temperature control

If all room sensors of a circuit fail, the controller will turn to an emergency operation mode for this circuit. The refrigeration relay switches on in certain intervals, preset by „*emergency operat*" (mode page). The total period is 30 minutes. E.g.: selecting emergency operation to 40% means 12 minutes on, 18 minutes off. As soon, as the sensor works correctly, emergency operation is finished and normal temperature control continues.



Temperature Alarm

Any over- or undertemperature condition results in a temperature alarm which causes the normally energized alarm relay to de-energize. Hereby the N/O-contacts open and the N/C-contacts close.
To avoid an alarm for short irregular conditions there is a delay time („*warning delay*“, setpoint page). The alarm condition is indicated by a LED at the front of the controller. The alarm is cancelled automatically if the temperature comes back to normal. During defrost periods, temperature alarm will be suppressed. "*remain alm delay*" shows the remaining time up to an alarm occurs.



Overtemperature Alarm
It is possible to select max. 4 alarm sensors for a circuit (e.g. 4x "*alarm sensor 1*"). If the temperature at any of the alarm sensors gets higher than the effective setpoint plus the „*warning offset*“ setting, an alarm will be initiated after the delay time.

Undertemperature Alarm
If the temperature at any alarm sensor gets lower than the „*warn low limit*“ setting, an alarm will come on with the delay explained above. This setting is an absolute value and does not refer to the control setpoint. Undertemperature alarm can be disabled by "*alm temp low*" (mode page).

Supplementary warning delay during defrost
After a defrost cycle the temperature might take longer to stabilize and the normal warning delay turns out to be too short. For this reason the „*defrost alarm delay*“ (defrost page) setting adds on to the normal warning delay after defrost.

Unit Text

In the mode page you have the possibility to define a specific text (max. 16 characters) for the controller, e.g. „apple-store“. This name will be indicated on the screen of the compound controller VPR 19000 or on a PC with the software ***COOLVision***.

Change text:

- select parameter „unit text“ (mode page)
- push „**PROG**“, the first character position flashes (eventually, you must enter the access code before)
- change character by the up/down-keys.
- press „**PROG**“ to confirm
- the next character flashes
- change this character by the up/down-keys.

....and so on

- press „**PROG**“ to confirm the last character.

Changing the text can also be made by the software 'COOLVision'.

Digital inputs (Optocoupler Inputs)

Switching OFF controller / Cooling Circuits

Sometimes it is necessary to switch off cold storages completely including the controller, but if this controller works in a network, the bus-master detects a malfunction and generates an alarm.

Controller Off
If a digital input is assigned to the function „*Unit OFF actHigh*“ and is connected to phase, all control functions are disabled. The display continues working, but no alarm will be activated. This is memorized in the list of the 'historical failures'. „*Unit OFF actLow*“ disables the functions with 0V at the digital input.

Circuit Off
Each digital input can be configured to switch off one ore more cooling circuits ("*circuit OFF X*"). When connected to phase, all regulation and control functions and temperature alarms of the concerned circuits are disabled. Nevertheless the others are still working. This is memorized in the list of the 'historical failures'.

Relay function 'unit on'

The function 'unit on', assigned to an output relay, has the effect that this relay keeps switched on during normal operation and keeps switched off while the controller unit is disabled by digital input or by interface. So this relay can be used to switch a function which should be active while the controller unit does not work.

Security Chain Monitoring

When using the controller for single compressor applications, one of the digital inputs can be used for monitoring the security devices ("*security chain*") of the compressor. Normally the digital input is connected to phase. But if the input is open, the controller waits for the timer „*sec chain delay*“ (setpoint page) then cooling and fan are switched off, a running defrost period is terminated and a new defrost start is impossible. The alarm relay will be activated. Parameter "*rem strt sec ch*" shows the remaining time up to a controller unit response.

Door Contact

Each control circuit can get a a door contact input. If the door contact input is connected to phase, the fan of the circuit stops immediately. If the door is open **> 3 minutes**, cooling will stop too. Parameter "*status*" shows the circuit which is switched off. If the door is open > 5 minutes, the failure message "*door X*" will be generated.
Cooling and fan will restart:
- when door is closed or
- when temperature exceeds the warning limits or
- when door opening exceeds the time set by „*door alm delay*“ (setpoint page). At the same time the alarm relay will be activated.

Exception:
If no alarm sensor is assigned or if the temperature is above the alarm limit „*warning offset*“, then cooling continues without interruption.
The cooling keeps switched ON and the fan starts again, so the door opening is ignored.

Door Open monitoring
Each time when door is open, the controller adds this time to the total opening time of that day „*door open x*“ (actual page). If the total opening time exceeds the time set by „*door time limit*“ (setpoint page) then an alarm will be generated. The failure message will be forwarded at the point in time determined by „*runtime mess at*“ (mode page) and is cancelled automatically 1 hour later. "*rem door open 1*" thru "*rem door open 4*" show the remaining time up to the alarm message.

Light

One of the relays can execute the function „*light*“, suitable to control lightings. In this case, the relay switches together with the night settings „*night setp. ON*“ and „*night setp. OFF*“ (mode page). During „day“ the relay is activated.

External Alarm

The digital inputs can execute the job „*alarm input x*“. While normal operation, the input is connected to mains phase. When the voltage drops down, a delay time starts „*OC inp alm delay*“ (setpoint page). After this timer is run down, a failure message will be generated.

Forced Refrigeration and Defrost Lock

See chapter 'Adding controller units'.

Display Language

The language used on display can be changed by "*Sprache/Language*" (mode page) to german, english, french or dutch.

Real Time Clock

The built-in real time clock is battery buffered, which works for (typ.) 3 years without mains voltage. Date and Time can be set on the 'mode page'.
An automatic summer / winter switching (parameter „*summer/ winter*“) considers the current EU-rules from 1996 (EU 96), but it can also switched off.

Analog Output

The TKP / TKC contains an analog output which can be used for regulation or to provide a remote display with an actual value image. The signal is available as a DC-Voltage or a DC-Current-Signal. Parameter „*analog value*“ (actual page) shows the current output signal as a %-part of the selected range, "*analog function*" (assignment page) determines the behaviour of the output:

Test functions

0V = voltage = 0V, current = 0 mA fixed
4mA = voltage = 2V, current = 4 mA fixed
10V/20mA = voltage = 10V, current = 20mA fixed

Transmission of actual values to remote displays or similar

act.img 0-10V = The outputs provide an image of the value of refrig.sensor 1.
voltage: -50°C = 0V, +100°C = 10V
current: -50°C = 0mA, +100°C = 20mA

act.img 4-20mA = The outputs provide an image of the value of refrig.sensor 1.
voltage: -50°C = 2V, +100°C = 10V
current: -50°C = 4mA, +100°C = 20mA

Control with the analog output signal (PI-control)

PID-T1 0-10V = This PID-controller with 0-10V DC-signal is assigned to cooling circuit 1. The output signal represents an addition of the components P, I, D and T1.

PID-T1 4-20mA = This PID-controller with 4/20mA-signal is assigned to cooling circuit 1. The output signal represents an addition of the components P, I, D and T1.

PID-T1 10-0V = PID-controller like above, but with inverted voltage output (rising temperature = falling voltage).

PID-T1 20-4mA = PID-controller like above, but with inverted 4/20 mA-output (rising temperature = falling current)

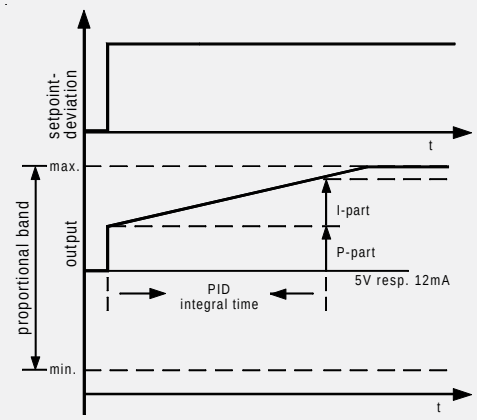
To adapt the controller to the process use the following parameters:

" PID propor band" ..... situated symmetrically to '*setpoint Ch 1*'
" PID integr time" ..... integral time (I-part)
" PID attack time" ..... derivative time (D-part)
" PID delay" ..... actuator response time (T1-part)

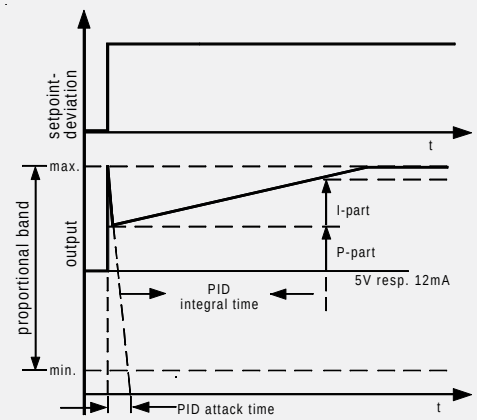
How to affect the analog output manually

For certain operations it might be usefull to affect the output signal manually. Therefore the function „*analog value*“ (assignment page) can be assigned to one of the digital inputs.
Applying mains phase to the digital input the analog output will be forced to the value (in %) that is programmed by „*opto->analogout*“ (setpoint page). So e.g. a connected valve drive will be set to a specific position.

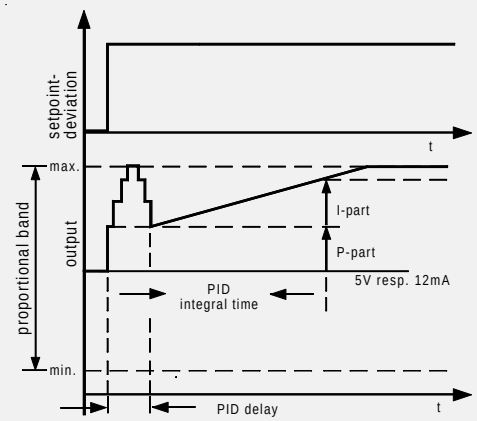
Control Characteristic



PI-control,
D and T1-parts
de-activated



PID-control,
T1-part
de-activated



PID-control,
with T1-
low-pass filter

Defrost

The controller allows several, different defrost methods. This methods are available for each of the 4 possible control circuits, that means it is possible to assign 4 defrost relays. This relay output(s) then control an electric heater or fan for defrosting the evaporator(s).
A defrost cycle can be initiated by different ways. Normally the internal clock is used, but there are also possibilities to start manual defrost or to use advanced functions to save energy.
Each evaporator with electric heater is monitored by a defrost sensor.
According to the application, choose if the fan stops or turns during defrost (parameter „*defrost type*“ on or off).

- „*defrost mode*“ (defrost page) determines how defrost starts:
  - *extern*
  defrost starts only when the digital input (OC-input) is activated
  - *extern+intern*
  defrost start by digital input or by the internal clock
  - *difference method*
  defrost on demand method which uses two supplementary sensors to measure the temperature difference across the evaporator
  - *dem defr by opti*(mization)
  defrost on demand method, defrost is started by the clock, but the pauses between the defrost cycles will be calculated
  - *adaptive*
  defrost control by the intelligent, adaptive function (only TKP/TKC x140, c.f. next pages)

An electric defrost heater is run from the N/O-contact of the defrost relay independent from the application (refrigeration/freezing).
Cooling is disabled during defrost automatically. "*last defr cycle 1*" thru "*last defr cycle 4*" (defrost page) show the expired defrost time of each circuit.

Defrost start by clock
A built-in timer allows you to set up to six (6) different times for defrosting within 24 hours („*defrost time 1*“ to „*defrost time 6*“, defrost-page). To disable these parameters, set them to „OFF“.
The defrost cycle starts only, if the temperature at one of the evaporator sensors is below the limitation setpoint "*defr temp limit X*".
If parameter „*defrost mode*“ on the mode page is set to „external“, the timer function is disabled.

Please note that this function differs with 'adaptive' defrost

Remote Defrost Initiation
To start defrost by digital input, note that mains phase has to be applied for 2 seconds minimum and last not longer than the shortest possible defrost cycle.

Pause ahead defrost
The parameter '*pause ahead defr*' (Defrost Page) causes that the defrost heaters will switch on delayed at the beginning of a defrost cycle. This gives a chance to pumpdown the evaporators before heating. So the defrost heaters need less energy, because the evaporator is already warmed up.

Defrost termination by temperature
Defrost will be terminated (individually for each output) by the corresponding defrost (evaporator) sensor. This sensors must be placed at a position where, by experience, ice remains the longest time. If the temperature rises at that position, the ice in the evaporator is probably melted completely.
A defrost cycle ends as soon as all defrost sensors have reached the defrost limitation temperatures „*defr temp limit X*“ (defrost page) or the safety time „*max defr Time*“ (defrost page) has been expired. If 2 defrost sensors are assigned to one circuit, both sensors must reach the limitation temperature to terminate defrost.

Defrost termination by time
In case that no defrost sensors are assigned or if they are out of order, the defrost cycle will be terminated if „*max defr Time*“ (defrost page) is achieved. Parameter „*remain defr time*“ (actual page) shows the time until expiration of this timer.

Defrost termination monitoring
Normally, a defrost period should be terminated if the temperature in the evaporator reaches the limitation temperature. In case of bad working conditions like sensor slack or similar, defrost is terminated by „*max defr time*“. If the number of defrost periods terminated by timer exceeds the number programmed by parameter „*n/o .def evnt>alm*“, a failure will be indicated.

In case of defrost by airflow without evaporator sensor, this function has to be disabled („OFF“), because here every defrost cycle is terminated by the timer.

Cooling Delay (drain time)
With „*pause aft defr*“ (defrost page) you can set a duration where the solenoid valve(s) are disabled after defrost termination. See the remaining time at „*remain defr pause x*“ (actual values page).

Manual Defrost
A manual defrost initiation via keypad is possible at any time.
Start : Select „*manual defrost*“ (defrost page).
Confirm „*start*“
Stop: Confirm „*finish*“.

Pulsed Defrost

To save energy and to avoid creating too much moisture it’s possible to work with a pulsed (switched in intervals) defrost function.
If the evaporator temperature is between „*pulse def limit*“ (defrost page) and the limitation temperature (the value of „*pulse def limit*“ must be lower than limitation temperature), the controller determines about the optimal heat distribution in the evaporator depending on the gradients of the temperature. If the evaporator temperature reaches „*pulse def limit*“, the heater is not longer heating continually but will be switched on and off by the controller in calculated periods until the defrost limitation temperature is reached.

As a result of this procedure
- heat energy in the evaporator dissipates better
- the defrost limit temperature can be set lower
- less of humidity in the chamber
- save of energy

To disable this function, set „*pulse defr limit*“ to a very high value.

Defrost on demand - Standard methods

Optimiziation Method (for walk-ins)

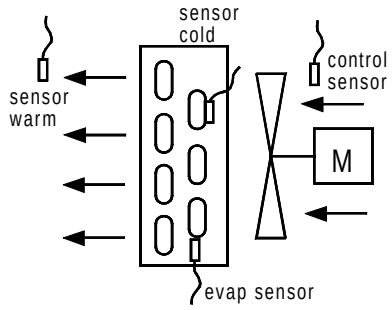
With every requested defrost cycle the controller detects the actual period of time needed for melting the icing at the evaporator around freezing point (between -2°C and +2°C). This time has a dependent relationship on the number of defrosts needed per day or, with other words, how many of the programmed defrost cycles can be skipped. The result of this calculation is displayed under parameter „*n/o defr ignored*“ (defrost page).

Melting-time	< 1 min	> 1 min	> 2 min	> 3 min	> 4 min	> 5 min	> 10 min
Defrosts to be skipped	6	5	4	3	2	1	no-ne

Defrost start will be initiated by the internal clock or a digital (OC)-input.
A manually initiated defrost cycle clears the 'skip' memory and starts a new calculation.

Defrost Demand by Differential Method

This defrost method uses two (2) additional sensors which sense the differential temperature across the evaporator. This differential increases with increased icing.
At a preset amount of icing (temperature differential) which is set by parameter „*demand defr diff*“ (defrost page), the controller starts a measuring cycle for a certain amount of time which is set by parameter „*dem defr period*“.



If, during this period, the differential reading keeps its value above setting, the controller stores the need of defrost (displayed by „*dem defr stored*“).

Any stored defrost demand results in initiating a defrost cycle at the next available defrost time (timer) or upon activating the defrost signal input.
For achieving good results with this demand defrost method, the two additional sensors must be placed carefully as explained in drawing.

Intelligent Defrost (adaptive defrost) for walk-ins *(TKP/TKC x140 only)*

Targets

Defrost too soon will squander energy by using too much heat-energy and defrosted too late will squander energy by decreasing the power factor of the refrigeration plant.

The main attribute of this ice detecting system, which is developed in co-operation with the company '*GÜNTNER Heat Exchangers*', is to recognize safely the rate of icing in the evaporator which can just be admitted and to start defrost when icing increases either immediately or in certain allowed periods.
The controller **adapts itself to a changed situation** and optimizes the control process, which we call the **autoadaptive defrost method**.

It is particularly suitable for cold storage chambers and enables the user to decrease the energy expenditure during the defrost process and increases the operational safety of the refrigeration unit.

Defrost itself should be made completely, using the less energy as possible.

The procedure should be suitable even for more than one evaporator and should not require special sensors, but use standard sensors.

Using this new defrost method is very easy:

- set parameter „*defrost mode*" (defrost page) to „adaptive"
- set parameter „*max time to defr*" (defrost page) to a value which is 2 or 3 times the normal defrost interval. Within this period decides about the point in time to defrost independly.
- parameter „*time to defr*" (defrost page) shows the time up to the next defrost.
- parameters „*pulse defr limit*" and „*defr temp limit*" define the range within the heater will be pulsed.
- set parameter „*defrost forerun*" to several minutes, so the fan will be started before defrost heater starts.
- set parameter „*fan off delay*" (setpoint page) to the time that the fan will continue running after cut-off of the cooling relay.

Process Sequence

1. If [setpoint + hysteresis > 2,5°C] the controller uses the fan to reduce icing.
2. In the time period set by „*max time to defr*" the controller decides itself if and at which moment a defrost cycle is necessary. If icing is detected, the controller prepares defrost and begins either immediately or at the next allowed defrost time.
3. Cooling stops, the fan goes on turning a certain time
4. The fan stops and the heater starts
5. If several evaporators are installed, each one has its own defrost sensor and heater relay, so it is individually heated.
6. When the „*pulse defrost limit*" is achieved, the heater will be cut off and on in calculated periods. The time spacing depends on the evaporator temperature.
7. Defrost heater is cut off completely when „*def temp limit X*" is reached.
8. Cooling and fan remain still off (drain time).
9. After the end of „*pause aft defrost*" cooling starts, but the fan remains still off.
10. After end of „*fan start delay*" the fan starts and normal refrigeration goes on.

Main Features

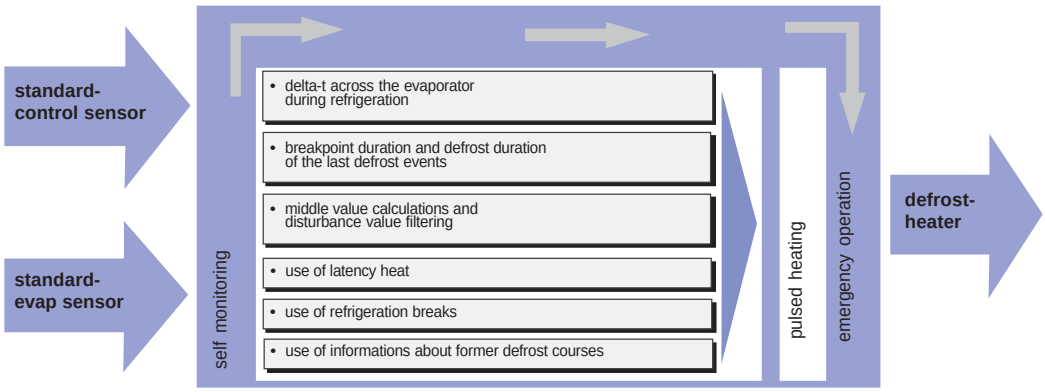
This defrost procedure fits especially for **cold stores** and freezers which are closed (like walk-ins), but it is **less efficient** in applications where the limitation sensor is located in the airflow (e.g. open chest freezers).

This procedure **reduces significantly the amount of energy** the refrigeration plant needs.

Especially while **difficult situations** (like high air-humidity, in cool-down chambers, while long opening times of the door of the cold storage room, uneven feeding of the cold storage room, etc.) the adaptive method protects the evaporator from glaciation safely.

Dynamic 'room-feeding' situations engage the controller to adapt itself to the new situation, without expensive adjustment by technical personnel.

Specialized sensors or additional probes are not required.



Intelligent Defrost (adaptive defrost) for walk-ins *(TKP/TKC x140 only)*

Refrigeration

Even during normal operation the fan stays on after cut-off of cooling to reduce icing.

Recognition of icing

The more ice on the fins the more increases the difference of temperature between the roomsensor and evaporator sensor. The controller uses the value of these sensors, their difference, the historic curves of these values as well as curves and duration of the past defrostings to calculate the necessity of defrosting.

Use of latent energy by airflow

We recommend to use „*defrost forerun*“ (defrost page) to switch on the fan several minutes ahead the defrost cycle, while cooling stops and the heater is not yet on.
Additionally, the fan is switched on automatically at a certain difference between the sensors. By this, the „cooling-energy“ is brought out of the evaporator and stored in the chamber. This helps also to reduce the amount of heat energy necessary to defrost.

Defrost start

If all six parameters „*defrost time ..*“ are set to Off, the controller decides itself when it starts defrost.

- *Further time influence*
  If you want to prevent that defrost starts at certain day-times use all the „*defrost time..*“ parameters and set them to points in time where defrost is allowed. If no icing is detected, these times will be ignored.
  On the other hand, once icing detected, the controller will wait for the next „*defrost time*“ before starting defrost.
- *External command*
  Assign one of the digital inputs to „*manual defrost*“. By applying voltage to that input it is possible to start defrosting at every moment.

Defrost heating

When „*pulse defrost limit*“ is achieved, the heater is cut off. The heat energy of the resistances will dissipate slowly and melt the ice. The length of the cut-off is calculated by the controller and as soon as some criteria are fulfilled, it will switch on the heater again.
The heater will be pulsed until the temperature of the evaporator sensor reaches the value of „*defrost temp. limit*“.

This procedure fits in the same way for the case of several evaporators in the chamber.
By this way defrost period will take longer, but will be more efficient.

Special mode for roomtemperatures > 2,5°C

Evaporators can be de-iced already at temperatures from 2°C by forced air. When cooling stops, fans are turning on until ice and frost are melted.
Thus humidity stays in the chamber which will improve the quality of certain goods like meat or vegetables.

Additonally to the compulsatory "*fan off delay*" (fan is forced to continue turning after cooling reached the setpoint and stopped), the fan will turn from a specific temperature [setpoint+hysteresis => +2,5°C] until the evaporator sensor has reached a certain value.

- At room temperatures [setpoint+hysteresis => +2,5°C] notify to set parameter „*max time to defr*“ to a higher value, because a defrost start is forced if this time is past.

Several evaporators in one chamber

For certain plants it is necessary to use several evaporators in one chamber. Even in this case one unique roomsensor is sufficient. E.g. for a chamber with 3 evaporators you need only 4 sensors:

- one controlsensor
- three defrost sensors (one for each evaporator)

Thanks to the ability of the controller to assign its inputs and outputs liberally it is able to control up to 4 evaporators in one chamber.

If a defrost cycle is necessary, all evaporators will start defrost at the same time to avoid short circuit of air, when one is heating and the fan of another is turning.

The one with the highest rate of icing determines the start of the defrost cycle. The TKP/TKC controller units are capable to **determine just this evaporator** and even to adapt it when conditions change.

Thus always the evaporator with the most ice initiates defrost start, nevertheless the quantity of energy which is necessary to defrost will be calculated for each evaporator separately.
To finish defrost cycle all evaporators must have reached the defrost limitation temperature.

Emergency operation for case of bad conditions

In cases if the controller recognizes that it would be incapable or to slow to control the process, or when it gets not enough informations, e.g.:

- charge of unusual very humid goods
- freezer door was open a very long time
- the evaporator is sprinkled with water
- sensor broken or shortened
- defrost terminated by the max. defrost time

the emergency operation starts.
To detect malfunction of the defrost control the unit uses the increasing of "*max. defrost time*".
If a defrost cycle is terminated by this time, the controller starts several defrosts with the interval which corresponds to (¼) one quarter of the time which is programmed by „*max time to defr*“.

Therefore be careful in choosing the time for this parameter.

After the end of the disturbance the controller works on normally.

Example
Max time to defrost is set to 24 hours. If defrost is not terminated by the evaporator sensor, the controller will start defrost cycle every 24 / 4 = 6 hours until a cycle will be finished by the evaporator sensor and not by timer.
Independent from this procedure, a failure message will be initiated.

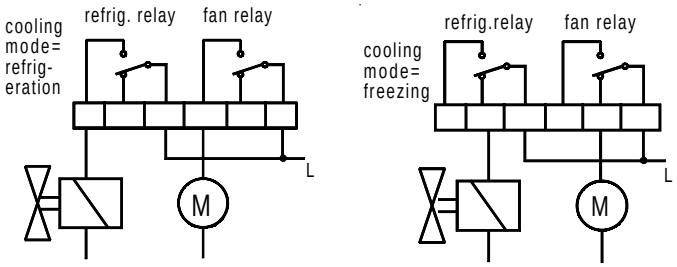
End of defrost

When the defrost sensor has reached the defrost limitation temperature, the heater stops and the controller waits until "*pause after defrost*" has expired, to allow the melted water to flow to the drainage.
Then cooling starts now, but the fans still stay OFF until the "*fan start delay*" has expired to allow the evaporator to cool down and to prevent that the fans blow warm and humid air or water drops into the chamber.

Evaporator Fan Control

For one or all of the 4 circuits it is possible to assign a relay for the evaporator fan. The fan control depends on the following parameters:

- „*cooling mode*“ (mode page)
  The fan is controlled from the N/O-contact in refrigeration mode and from the N/C-contact in freezing mode.



- „*fan operation*“ (mode page)
  You can select either „permanent“, where the fan runs continously and stops only during electric defrost, or select „interval“, where the fan runs during cooling periods only.

- „*defrost type*“ (defrost page)
  If „on“: fan turns during defrost
  If „off“: fan ist stopped during defrost.

Fan off delay

To use latent energy of the ice and evaporator block the fan can turn up to 30 minutes after the cut-off of the valve or compressor („*fan off delay*“, setpoint page).

Fan trailing delay

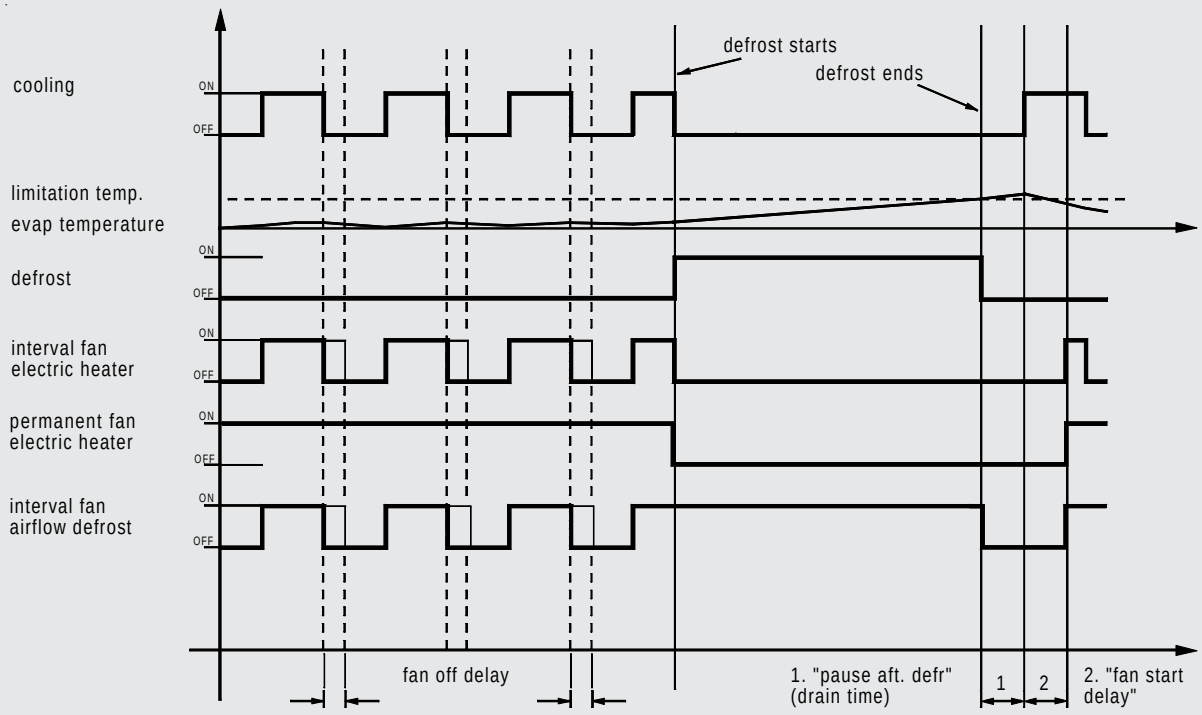
The start-up time delay for the fan after defrosting is set with parameter „*fan start delay*“ (setpoint page). This avoids that water drops will be blown into the chamber. "*rem fandelay 1*" thru "*rem fandelay 4*" (actual page) show the remaining time up to the fans in the single circuits will be switched on.

Examples for fan operation modes

1. *fan in permanent mode*
   This mode is mainly used with refrigerated shelfs, refrigerated display counters and chest freezers, where the fan runs even during defrost. It is not necessary to connect the fans to a relay of the controller, fans run directly from mains voltage. "*fan operation*" is set to 'permanent', "*defrost type*" is set to 'on' and "*pause aft. defr*" is set to '0'.
2. *fan in interval mode, defrost by fan*
   In use for cold storage chambers with higher temperatures. Use a relay output for the fan. In this case you select „*fan operation*“='interval' and „*defrost type*“='on'.
3. *fan in interval mode, defrost by electric heater/hot gaz:*
   In use for cold storage chambers with lower temperatures and freezers. Use a relay output for the fan. In this case you select „*fan operation*“='interval' and „*defrost type*“='off'. The fan runs when cooling is on. The fan is disabled during defrost periods and comes on after defrost with a time delay which is set by the „*fan start delay*“ parameter.
4. *fan in permanent mode and defrost by electric heater*
   Use a relay output for the fan. In this case you select „*fan operation*“='permanent' and „defrost type“='off'. Then the fan will run continously and stops during a defrost period only. The fan comes on after defrost with a time delay which is set by the „*fan start delay*“ parameter.

Please note that the fan relay contacts change with the application (refrigeration/freezing).

Fan operation modes, defrost termination using electric heaters



Roller Blind control

Selecting the „roller blind“ function on the assignment page activates the relay output for opening and closing the roller blind(s) automatically. A defrost overrides this function and opens the roller blind(s) for the defrost period.

Internal control

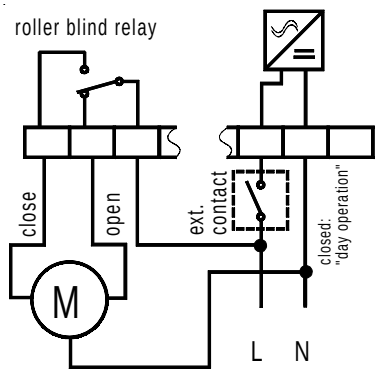
- Therefore don't use a digital input assigned with the function „night settings“ or the digital input must be connected to mains voltage (= day operation).

  The timer parameters „*night setp ON*“ and „*night setp OFF*“ (mode page) are activating not only the secondary setpoint(s) but have also an effect on the roller blind.

  The ON setting activates the roller blind relay and runs the roller blind in closed position via N/O-contact. The OFF setting time de-activates the relay thus opening the roller blind again.

External control

- Therefore use a digital input and assign it to the function „*night settings*“. If the digital input is connected to mains voltage (phase), the unit works in day-mode.



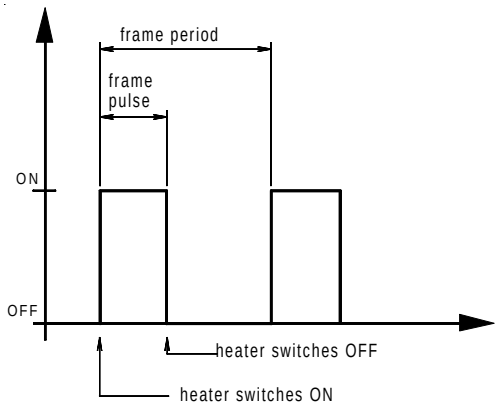
This results in de-energizing the relay when „roller blind“ is selected and running the blind(s) open via the N/C-contact. An open input means night-mode and runs the roller blind(s) shut via the N/O-contact.

Frame Heater control

Frame heaters are used for freezers to avoid the door freezing onto the door frame. In addition it prevents condensing water around the door or on top of the frames of open chest freezers.
If one of the relays is assigned to „frame heater“ this will control the energy to the frame heater with a certain frequency and pulse-width. For day and night operation you can choose different values to save energy.

The corresponding parameters on the mode page are:

- „*frame period*“: defines the duration of the cycle,
- „*frame pulse day*“ defines the percentage of heating during day operation within each cycle. 100% = continuous heating, 0% = off
- „*frame pulse night*“ defines the percentage of heating during night operation within each cycle. 100% = continuous heating, 0% = off



Adding controller units to extend cold storages

If one controller unit has not enough ressources to control a cold storage, you can add one or more units. The necessary communication is made by the digital inputs.

Each of the digital inputs can be assigned to the following jobs:

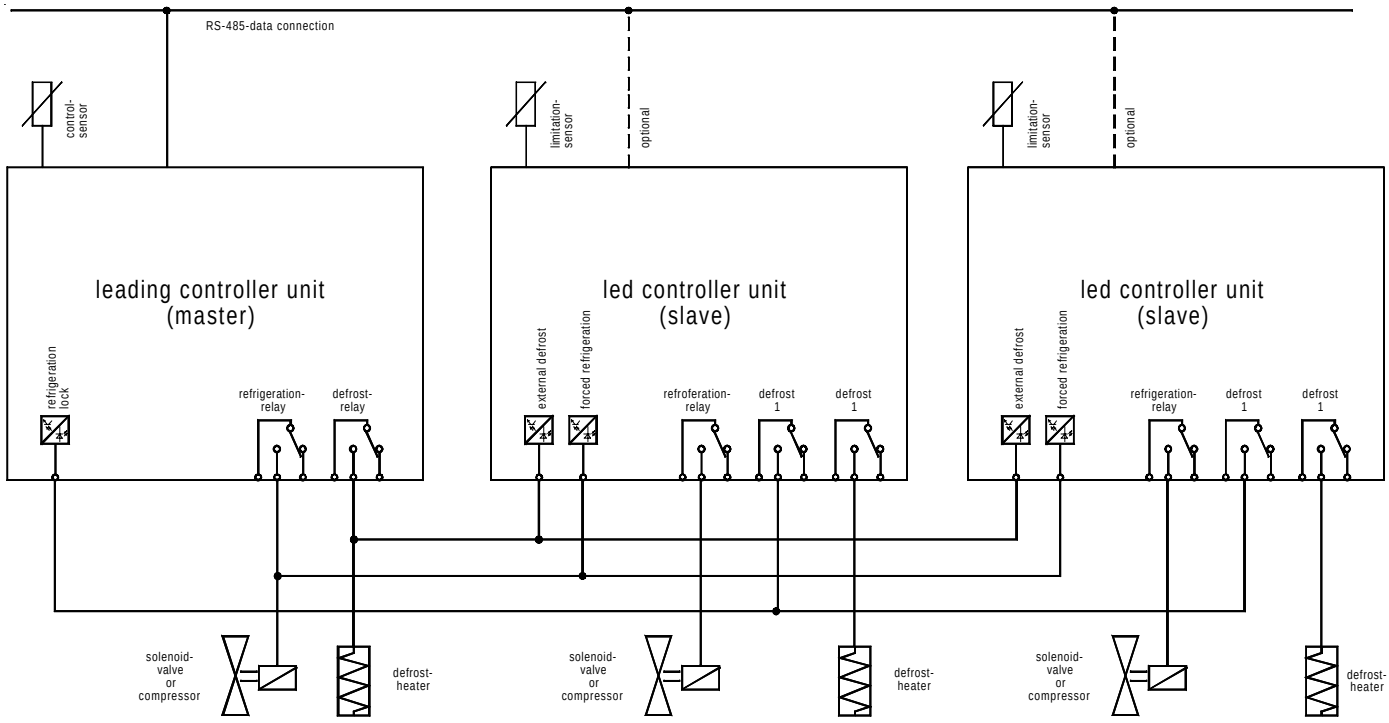
Refrigeration Lock (avtive low): The refrigeration function of the controller unit will be stopped as long as 0Vare connected to the control input.

Refrigeration Lock (avtive high): The refrigeration function of the controller unit will be stopped as long as mains voltage is connected to the digital input.

Forced Refrigeration (active low): The refrigeration function of the controller unit will be forced as long as 0Vare connected to the digital input.

Forced Refrigeration (active high): The refrigeration function of the controller unit will be forced as long as mains voltage is connected to the digital input.

Principle of adding controller units:



The leading unit engages the cooling function of the 'slave'-units via their digital input 'Forced Refrigeration'. The 'slave'-units disable the cooling function at the 'master'-unit via its digital input 'Refrigeration Lock', as long as a defrost function works.

Networking of controllers via *E-LINK*

E-LINK

This controllers can be networked together with other ELREHA-control devices. For this duty ELREHA has developed E-LINK, a transmission protocol, which will be transmitted on a two-wire bus-system based on the RS-485-Standard. With E-LINK, up to **78** controllers can be assembled.
Each controller in a network has its individual adress („*adress in netwk*“, mode page). This adress is necessary for selecting the right controller while a data package is transmitted on the network bus. If the controllers are used outside a network, the adress and the parameter „*compound*“ are of no importance.

Remote control with SMZ

The TKP/ TKC controller series can be operated via interface when they are connected to a communication module SMZ 3130. The SMZ will display exactly the same as at the TKP/TKC; the keys of the SMZ work as if they where the keys of the TKP/TKC. So you can get alarm messages from your equipment and you can control the device remotely .

Configuration / Service via PC

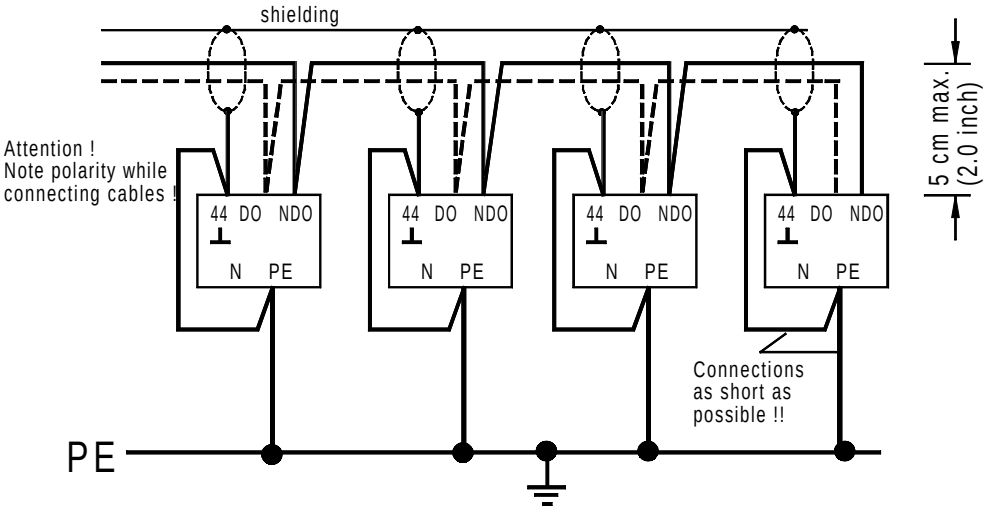
The controllers can be linked via RS 232 or RS 485 interface to a PC where the ELREHA-software „Coolvision“ works. From there you can change parameters, save them on the hard disk (download) and send it to other controllers (upload).

Wiring of data lines

The scheme beside shows briefly, how dataline wiring of several controllers must be made. The shield has to be grounded at each controller to the PE-contact and to the GND contact of the RS485!
This will assure good interference suppression, even for long datalines between the controllers.

GND-terminals

TKP 31x0 ..... term. 44
TKC 51x0 ..... term. 40
TKC 191x0 ... term.d32, analog PCB



Communication with compound controller VPR 19000

The TKP/TKC controller can be used as intelligent cold storage controller in co-operation with our compound control system VPR 19000. In this case, the VPR central processing unit will control the TKP/TKC.

When the TKP/TKC's are connected to the compound controller each one needs an individual adress („*adress in netwk*“, mode page)

For the TKP/TKC's there is a possibility of assigning each controller to a certain compound (Refrigeration or Freezing, „*compound*“, mode page). This enables the VPR to transmit specific informations to the cold storage controllers assigned to the compound within a failure occurs.
More detailed informations you will find in the technical manual of the VPR 19000 compound system.

Behavior in case of the VPR-function 'Low Power Optimization'

If this feature is used in the VPR-system, the VPR can disable the refrigeration functions of the TKP/TKC for a certain time, even though the refrigeration setpoint is increased. The fans and the heating continues working, they will be disabled in case of compound failure only .

Behavior in case of compound failure

If a TKP/TKC is assigned to a certain compound and a disturbance occurs, the unit responds as follows:
- The solenoid valves will be closed
- The fan is switched off
- A defrost period will be terminated. A new defrost cycle is only possible when the compound problem is solved.

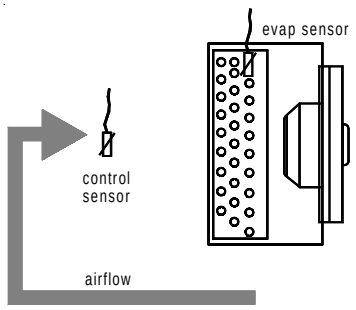
To see if this function is released, look at „*solenoid valve*“ (actual values page).

Data transmission disturbances

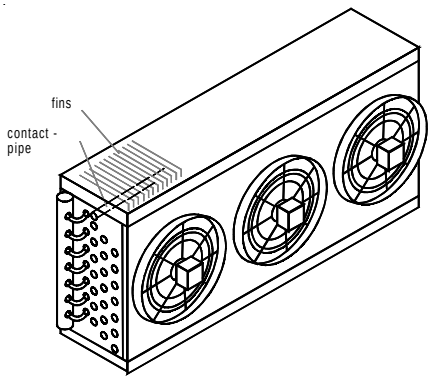
If the controller gets no new informations from the VPR, it continues working with the actual settings.
If there was an order from the VPR to close the solenoid valves and a technical defect interupts the data transmission for more than 30 minutes, the TKP/TKC ignores this order and starts working normally. When data transmission is restored, the TKP/TKC will work again immediately according to the commands of the VPR.

Sensor Positions

The controller needs correct temperature input information to work correctly, but sensor positions are not critical.
The **control sensor** for regulation or **alarmsensor** has to be fixed behind the evaporator (air inlet) or at a representative place in the chamber, but not in the air outlet



The second sensor (**defrost sensor** or **evaporator sensor**) should be assembled in the tube which is factory provided for this purpose. If the evaporator has not such a tube, assemble it between the fins in the upper part and assure a good thermal exchange. It should be placed at the position where the icing stays the longest time when defrosting. This depends of type and manufacturer of the evaporator, so use your experience.
Make sure that the sensor doesn't touch the heater or any piping with hot gas defrost, it must have some distance to these heat sources.

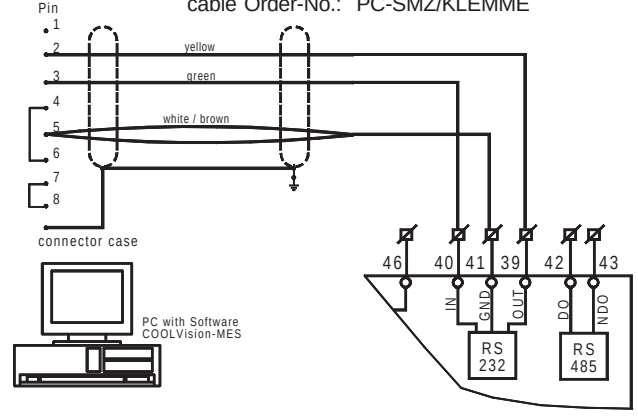


We indicate that remaining ice in an evaporator even after a defrost period is due to sensors which have not enough thermal contact or which are installed at a wrong place. If you encount icing you should place the defrost sensor to this area.

Sensors for demand defrost (TKP x140)
To detect icing the TKP x140 does not need more sensors than the normal ones. The controlsensor and the defrost sensor are sufficient.

Sensors for demand defrost (TKP x130)
If the TKP x130 is set to demand defrost by differential method two additional sensors are necessary to record the temperature difference across the evaporator. Mount the „cold" sensor directly to the 2nd or 3rd elbow of the evaporator tube and the „warm" sensor in the evaporator outlet air (but not above the fan - the motor will dissipate heat when cut off). Control sensor and defrost sensor are placed in the same way as explained above.

PC-connection of a single controller for configuration- or service purposes.
cable Order-No.: PC-SMZ/KLEMME



Installation / Getting Started

Upon applying voltage to the controller, the display shows after a few seconds type, date and time or the parameter which is selected as permanent display, the display backlight is off. Pressing any key turns the backlight on. If the controller is applied to voltage the first time, you are now invited to change or confirm the language.

Putting into operation

- check and/or set the actual time and date of the controller
- determine the function of all inputs and outputs on the assignment page. (only possible in the 'configuration level', which is the factory setting. See also page 11). Unless you haven't done this, you will not see all necessary parameters on the other pages!
- select type of used temperature sensors („*sensor*", mode page).
- correct the displayed temperature values if necessary („*corr sensor..*", mode page).
- set date and time
- select the desired „defrost mode" (defrost page) and if the fan should turn during defrost or not.
- select cooling mode on mode page
  (note: will influence the electrical connection of the relay.)

These are the most important steps for the basic configuration of the controller. Upon that, adapt the other parameters like temperature setpoint, hysteresis, delay times.... Refer to the previous chapters in this manual.

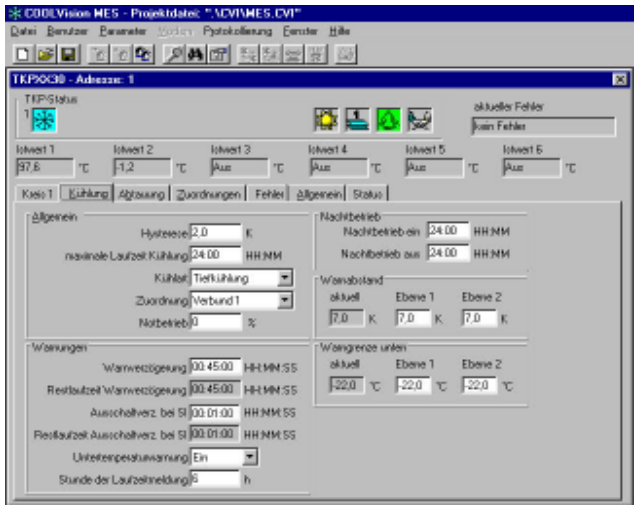
Start-up in a data network

- set the adress of the controller (mode page)
- verify the baudrate (mode page)
- Load the parameters form the PC to the controller (upload).

Start-up with a PC/Laptop

The start-up of the controller can be much easier by using a PC and the software "COOLVision-MES". In this case the controller will be connected via the RS-232 interface.

- set the adress of the controller (mode page)
- remote control of the unit from the PC



As a result of its text display the controller offers you the chance of getting an overview about the plant in a very short time.
E.g. possibility to see the values of:

- temperatures (all sensors)
- analog value
- state of the relais
- remaining delay times
- state of the digital inputs
- actual and historic failures

If failures are present, they are listed on "act.failure page"

Basic Configuration of TKP 3130/1

Because the TKP 3130/1 has no own operating elements and no display, the basic configuration must be done in a special way.

Sequence

- **Note:** The network adress of the cntroller unit ("*adress in netwk*", Mode Page) is factory set to '78'.
- Prepare VPR-System
- Connect a single TKP 3130/1 to the RS-485-Line interface.
- Open subpage "Service Data" at the VPR-Display.
- Set desired network adress for the TKP at parameter "*Change CST adress*".
- The new adress will be transmitted to the TKP.
- As usual, the TKP can be inserted and programmed on the CST-pages of the VPR-System.
- Connect next controller to the interface and repeat procedure.

During configuration, also multiple controller units can be connected to the line-interface.
It makes sense that only one of this owns the adress '78', because the configuration function transmits the new adress only to units with the factory set adress '78'.

Connecting multiple new TKP 3130/1 at the same time doesn't work.

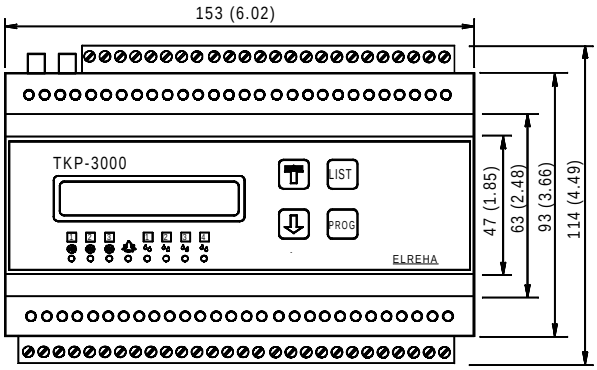
With this controller type, only sensors of the TF 501 series (Pt1000) can be used.

CONNECTION & SAFETY INFORMATIONS

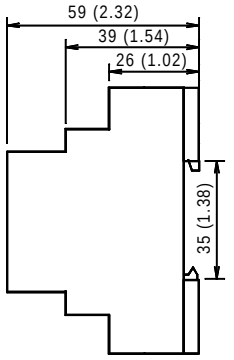
Please read before Start-up

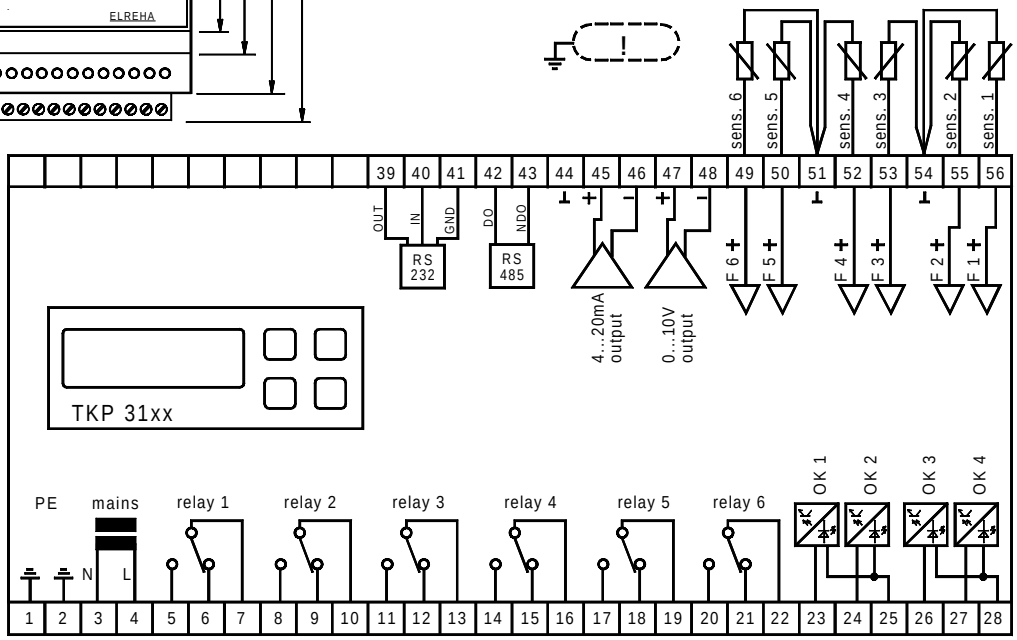
- Limit of Application: This product is not designed nor manufactured for use in equipment or systems that are intended to be used under such circumstances that may affect human life.
  For applications requiring extremely high reliability, please contact the manufacturer first
- Electrical installation and putting into service must be done from authorized personnel.
- Please note the local safety instructions !
- Before installation: Check the limits of the controller and your application. Before starting up we recommend you to read the following instructions for use, since only by doing so you can avoid damage or malfunction and you will benefit all the advantages offered by this product.
- **During installation and wiring never work when the electricity is not cut-off !**
- Mounting the controller close to power relays is unfavourable in case of the electro-magnetic interference.
- Before applying voltage to the controller:
  Make sure that all wiring has been made in accordance with the wiring diagram in this manual.
  Check, if the supply voltage corresponds to the value printed on the type label.
- Connect the 'PE' terminal carefully to ground because otherwise the operation of the internal noise filter will be disabled.
- Respect the environmental limits for temperature and humidity. Outside these limits malfunctions may occur.
- **Never operate unit without housing.**
- In case of malfunction or doubts please contact our technical support.
- Observe the maximum admitted current rate for the relays (see technical data). Compare with the peak start-up current of the controlled devices (valve, fan, compressor, heater..)
- Sensor cables may be up to some hundred meters in length. Use shielded sensor cable only. Don't install them in parallel with high-current cables to prevent inductive interference. A cross section of min. 0,5mm² is sufficient.
- Shielding has to be connected to PE at the end near the controller
- All used temperature sensors must be identical. Never use PTC (TF 201) and PT1000 (TF 501) mixed. This will not work.
- TF-type sensors are moisture-proof but they are not designed for being immersed in water for a long period of time (not pressure-proof). In such a case, always use dip-fittings.
- Be care that the wiring of interface lines meets the requirements

Dimensions and Wiring TKP 3130 / 3130/1 and 3140

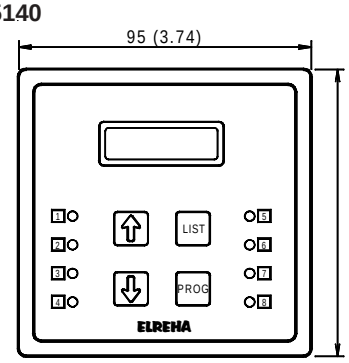


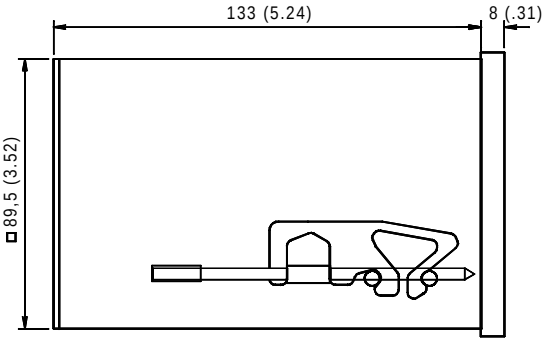
3130/1:
Without display and operating keys

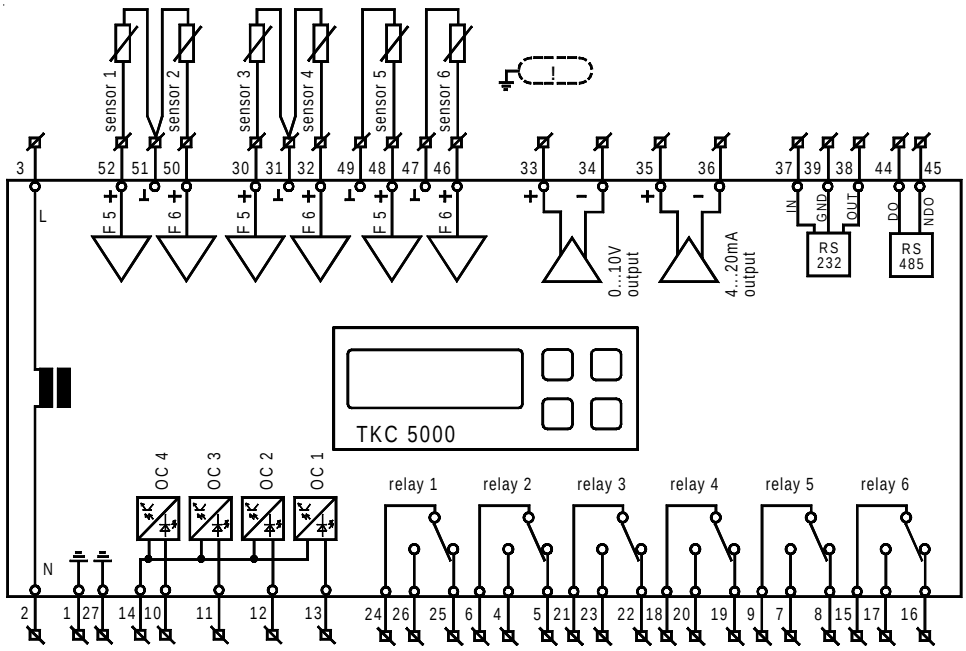


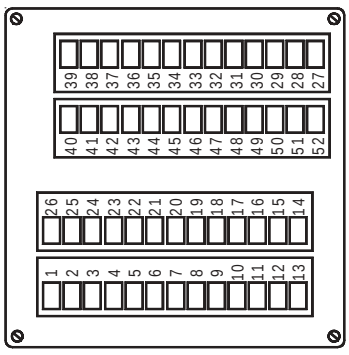


Dimensions and Wiring TKC 5130 / 5140



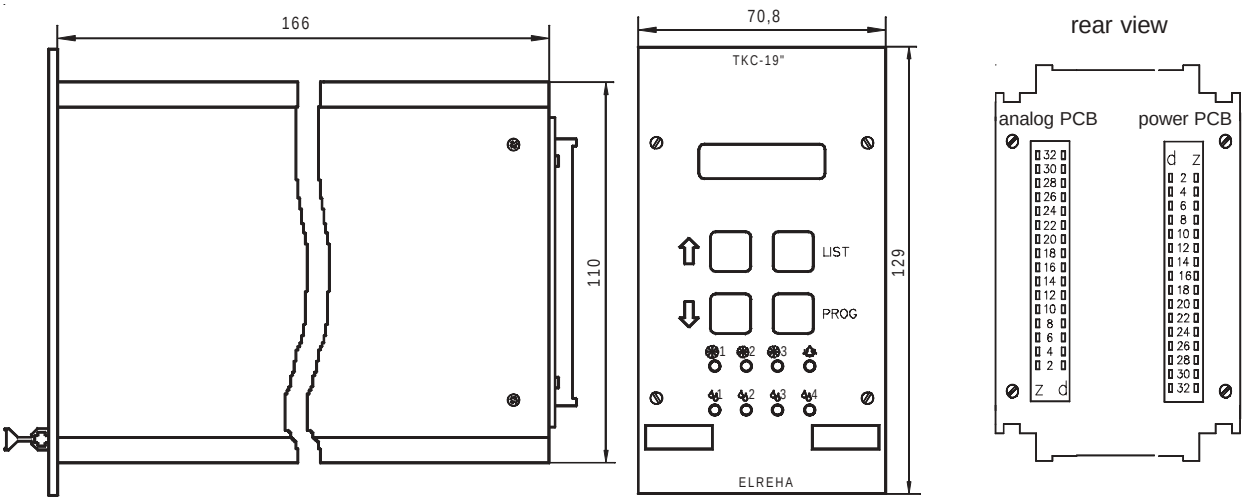




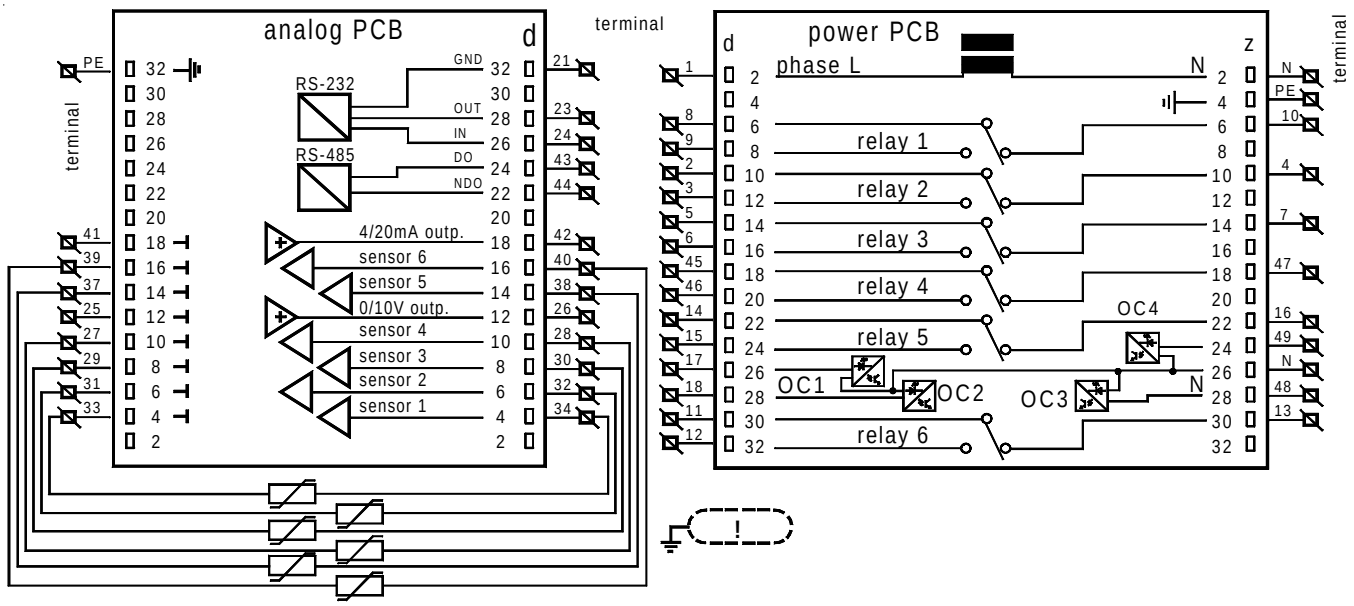


rear view

Dimensions TKC 19130 / 19140



Wiring TKC 19130 / 19140



This diagram shows a connector type "F", DIN 41612, rear view.
The terminal numbers are used in factory pre-wired subracks.

Technical Data

Supply voltage ..... see 'Available Types', page 2
Power consumption ..... appr. 5VA
Ambient temperature ..... 0...+60°C
Ambient humidity ..... max. 85% r.H., not condensing
Inputs ..... 6x temperature sensor
TF 201 (PTC) or TF 501 (Pt1000)
Digital- (OC) inputs ..... 4x mains voltage, 3mA max.
Relay outputs ..... 6x SPDT, isolated
contact rating:
8A cosphi=1, 3A inductive / 250VAC
Analogue outputs ..... 0...10V, 0/4...20mA
Ranges ..... see parameter pages
Interfaces ..... RS 232, RS 485,
Data storage ..... typ. 10 years without mains voltage
Real time clock ..... x-tal, with automatic
summer/winter switching
Housing TKP 31x0 ..... plastic, for 35mm DIN-rails
pluggable screw terminals, IP 30
TKC 51x0 ..... plastic, panel mounting, frame
dimensions 96 x 96mm, pluggable
screw terminals, IP 54 from front
TKC 191x0 ..... 19"-Al-cassette

Accessories

- Temperature sensors TF 201 or TF 501, quantity depends on your application
- PC-Software "**COOLVision**" or software module "**COOLVision-MES**" for remote control and configuration only.
  Modules "**COOLVision-Analyse**" and "**COOLVision-SMM**" are used for value recording, graphical visualization and failure message forwarding.

TKC 191x0:

- female connectors with solder tags or plat plugs
- 19"-subrack or panel mounting enclosure

manufactured by:
ELREHA **Elektronische Regelungen GmbH**

D-68766 Hockenheim, germany
Schwetzinger Str. 103

phone ..... 0 62 05 / 2009-0
fax phone ..... 0 62 05 / 2009-39
Internet ..... www.elreha.de
e-mail ..... team@elreha.de

EG-Konformitätserklärung *EG-Statement of Conformity*

CE

Für das beschriebene Erzeugnis wird hiermit bestätigt, daß bei bestimmungsgemäßem Gebrauch die Anforderungen eingehalten werden, die in der Richtlinie des Rates zur Angleichung der Rechtsvorschriften der Mitgliedsstaaten über die elektromagnetische Verträglichkeit (89/336/EWG) festgelegt sind. Diese Erklärung gilt für alle Exemplare, auf die sich die vorliegende Bedienungsanleitung (die selbst Bestandteil dieser Erklärung ist) bezieht.

We state the following: When operated in accordance with the technical manual, the criteria have been met that are outlined in the guidelines of the council for alignment of statutory orders of the member states on electro-magnetic consistency. (89/336/EWG) This declaration is valid for those products covered by the technical manual which itself is part of the declaration.

Zur Beurteilung des Erzeugnisses hinsichtlich elektromagnetischer Verträglichkeit wurden folgende Normen herangezogen:

Following standards were consulted for the confirmity testing with regard to electromagnetic consistency :

IEC 1000-4-1, IEC 1000-4-2, IEC 1000-4-3*, IEC 1000-4-4, IEC 1000-4-5, EN 55011 B, EN 50081, Teil 1 und 2; EN 50082, Teil 1 und 2

Diese Erklärung wird verantwortlich vom Hersteller/Importeur
This statement is made from the manufacturer / importer

ELREHA Elektronische Regelungen GmbH
68766 Hockenheim
(Name / Anschrift / *name / adress*)

abgegeben durch:
by:

Klaus Birkner,.....
Entwicklung und Leiter des EMV-Labors.....
Hockenheim.....**19.12.95**.....
Ort/*city* Datum/*date* Unterschrift/*sign*

*Die Einhaltung des Grenzwertes nach IEC 1000-4-3 wird aus den vorgenommen Messungen nach IEC 1000-4-2 und IEC 1000-4-4 abgeleitet. Die Korrelation auf IEC 1000-4-3 basiert auf entsprechenden Versuchsmessungen, deren Ergebnisse beim Hersteller hinterlegt sind.

**The conformity with IEC 1000-4-3 is derived from the IEC 1000-4-2 and IEC 1000-4-4 test results. The correlation with IEC 1000-4-3 is based on test results which are located on site at the manufacturer.*

This manual, which is part of the product, has been set up with care and our best knowledge, but mistakes are still possible. If you have any problems, difficulties or questions please don't hesitate asking our technical support.
Technical details can be changed without notice, especially the software. Please note that the described functions are only valid for units containing the software with the version-number shown on page 1 of this manual.
Units with an other version number can work a little bit different. You will find this version number also in the "mode page" at parameter "*program version*".

set up : 10.1.05, tkd/jr	checked: 10.1.05, ek/jk	approved: 10.1.05, mv/sha